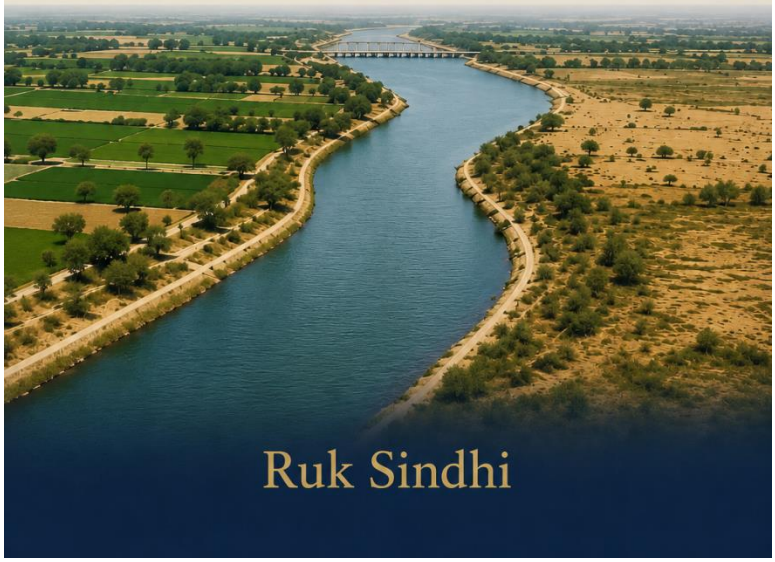
The Nara River System of Sindh:

Geoarchaeology, Hydrological Evolution, and the Indus Civilization



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NARA BASIN: History, Geography, Archaeology, and Modern Research

A Comprehensive Interdisciplinary Study of the Nara Basin in the Light of Historical Sources, Archaeological Evidence, Geoarchaeology, Hydrology, and Contemporary Scientific Research

Table of Contents

Preface

1. ABSTRACT
2. Introduction
3. Review of Literature
4. Geographical, Geological, and Hydrological Evolution of the Nara Basin
5. Archaeology of the Nara Basin and the Indus Civilization
6. Major Archaeological Sites of the Nara Basin: A Critical Review
7. The Archaeological Landscape of the Nara Basin: Ancient Sites and Settlement Systems of Eastern Sindh
8. The Economic System of the Nara Basin: Agriculture, Irrigation, Craft Production, and Trade Networks
9. General Discussion, Scholarly Synthesis, and Chapter Conclusion
10. The Nara in the Historical Period: From the Islamic Era to the Modern Irrigation System

11. The Hydraulic System of the Nara During the Kalhora and Talpur Periods: Restoration, Agricultural Development, and Administrative Policies
12. Formation of the Nara Canal in the British Era: From Eastern Nara to Sukkur Barrage
13. Evolution of the Nara Canal after the Creation of Pakistan: Modern Irrigation System, Water Management, and Environmental Challenges
14. Archaeology of the Nara Basin: Ancient Sites, Cultural Continuity, and Modern Archaeological Research
15. Major Archaeological Sites of the Nara Basin: Geographic Distribution, Cultural Features, and Archaeological Significance
16. Settlement Patterns, Palaeoenvironment, and Human Adaptation in the Nara Basin
17. Material Culture of the Nara Basin: Analytical Study of Archaeological Evidence
18. Beads, Ornaments, Metallurgy, Lithic Tools, and Other Craft Industries: Archaeological Review
19. Trade System, Communication Routes, and Economic Organization of the Nara Basin:

Analytical Review of Interregional Connections in the Indus Civilization
20. Social, Religious, and Cultural Life of the Nara Basin: A Critical Study in Light of Archaeological Evidence
21. Decline of the Nara Basin, Environmental Changes, and the Hakra–Nara Debate: A Critical Review in Light of Modern Scientific Research
22. Conclusions, Scholarly Analysis, Research Discussion, and Future Directions
23. Nara Basin: A Holistic Review of History, Geography, Archaeology, and Modern Scientific Research
24. Recommendations

Appendices

Glossary of Terms

REFERENCES

Preface

The history, geography, and civilization of Sindh cannot be fully understood without examining the history of its rivers. The Indus River has long served not only as the lifeline of the region but also as the foundation upon which successive distributaries, abandoned channels, and seasonal river courses have sustained human settlement, agriculture, trade, and cultural development for thousands of years. Among these fluvial systems, the Nara occupies a distinctive position. Throughout history, it has been interpreted in different ways: as an ancient natural river channel, as a former distributary of the Indus, as part of the Puran River, as the southern continuation of the Hakra River, and, in modern times, as one of Pakistan's most significant irrigation canals. Consequently, the history of the Nara is far more than the history of a canal or a river; it is an integral part of the environmental, historical, and civilizational development of Sindh itself.

The existing scholarly literature on the Nara presents a wide range of interpretations, hypotheses, and research findings. From the surveys conducted by nineteenth-century British administrators, engineers, and geographers to the investigations of contemporary geoarchaeologists, geologists, geomorphologists, and hydrologists, numerous scholars have sought to explain the origin, evolution, course, and historical significance of this remarkable fluvial system. Some researchers have regarded the Nara as an ancient distributary of the Indus River, whereas others have associated it with the southern extension of the Hakra–Ghaggar system. More recent scientific investigations,

particularly those employing remote sensing, satellite imagery, geomorphological analysis, sedimentological studies, Optically Stimulated Luminescence (OSL) dating, isotope hydrology, and Geographic Information Systems (GIS), have provided new opportunities to reassess these earlier interpretations. Increasingly, the evidence suggests that eastern Sindh was characterized not by a single, stable river system but by a dynamic network of multiple channels that shifted repeatedly in response to tectonic activity, climatic variability, and changing hydrological conditions.

The significance of the Nara extends well beyond the field of physical geography. It is equally important for understanding the settlement geography of the Indus Civilization, the development of ancient agricultural systems, regional trade networks, patterns of human migration, and the long-term interaction between human societies and water resources. Numerous archaeological sites distributed across eastern Sindh, Tharparkar, and Cholistan are situated adjacent to ancient fluvial corridors, providing compelling evidence that the availability of reliable water and fertile alluvial soils was a decisive factor in the establishment and growth of prehistoric settlements. Accordingly, any comprehensive reconstruction of the environmental history of the Indus Civilization must also consider the evolution of the Nara and its associated river systems.

The history of the Nara entered a new phase during the British colonial period. Through the introduction of modern irrigation engineering, the construction of the Sukkur Barrage, and the development of an extensive canal network, the ancient river course was transformed into a modern irrigation canal designed to serve the agricultural needs of eastern Sindh. While these engineering works

significantly enhanced agricultural productivity and reshaped the regional economy, they also generated new scholarly questions concerning the original nature of the ancient channel and its relationship with earlier river systems—questions that continue to stimulate academic debate today.

This book represents an attempt to examine these issues through a comprehensive and critical interdisciplinary approach. It integrates historical documents, colonial survey reports, early geographical accounts, archaeological evidence, geoarchaeological investigations, geological research, remote sensing analyses, satellite imagery, and Geographic Information Systems (GIS) in order to construct a scientifically grounded interpretation of the origin and evolution of the Nara. Rather than relying upon a single category of evidence, the study synthesizes multiple lines of inquiry to produce a more balanced and comprehensive understanding of the region's fluvial history.

The purpose of this work is not to advocate any particular hypothesis but to evaluate competing interpretations critically in the light of available evidence. By bringing together historical sources, archaeological discoveries, and recent scientific investigations within an interdisciplinary analytical framework, this study seeks to explain the evolution of the Nara, its relationship with the Puran and Hakra river systems, its contribution to the settlement patterns of the Indus Civilization, and its subsequent transformation into a major component of Sindh's modern irrigation infrastructure.

It is hoped that this volume will make a meaningful contribution to the study of Sindh's hydrological history, the environmental context of the Indus Civilization, ancient

river systems, and the emerging field of geoarchaeology. It is further hoped that the research presented here will stimulate new questions, encourage interdisciplinary collaboration, and provide a stronger scientific foundation for future investigations into the evolution of the Nara and the palaeohydrology of eastern Sindh.

Finally, I wish to express my sincere appreciation to the many historians, archaeologists, geologists, geomorphologists, geographers, and hydrologists whose research has provided the intellectual foundation for this study. If this book succeeds in enriching scholarly understanding of Sindh's hydraulic heritage, its ancient environmental history, and the fluvial landscapes associated with the Indus Civilization, it will have fulfilled its principal objective.

ABSTRACT

The Nara Basin constitutes one of the most historically and archaeologically significant cultural landscapes in South Asia. Extending across eastern Sindh and historically connected with the Hakra–Ghaggar fluvial system, the basin has long attracted scholarly attention because of its relationship with the development of the Indus Civilisation, ancient river dynamics, environmental change, and the evolution of settlement patterns. Despite more than a century of archaeological exploration and historical investigation, many aspects of the basin's origin, hydrological evolution, and role in regional cultural development remain the subject of scholarly debate. This thesis presents a comprehensive interdisciplinary investigation of the Nara Basin by integrating historical geography, archaeology, geoarchaeology, hydrology, geomorphology, remote sensing, palaeoenvironmental studies, and contemporary scientific research.

The principal objective of this research is to examine the historical evolution of the Nara Basin from prehistoric times to the modern period and to evaluate its significance within the broader context of the Indus Civilisation and the ancient river systems of north-western South Asia. Particular attention is devoted to reconstructing the palaeohydrological history of the basin, assessing the archaeological evidence associated with settlements along the ancient river courses, and critically analysing competing interpretations regarding the relationship between the Nara, the Hakra, the Ghaggar, the Puran, and the debated Saraswati River.

This study employs an interdisciplinary research methodology combining qualitative historical analysis with archaeological interpretation and environmental reconstruction. Primary historical sources, including colonial gazetteers, administrative reports, travellers' accounts, historical maps, and irrigation records, have been examined alongside archaeological excavation reports, regional surveys, geological investigations, hydrological studies, and geoarchaeological research. Modern scientific evidence derived from Geographic Information Systems (GIS), satellite remote sensing, digital elevation models, sedimentological analyses,

palaeoclimate research, and palaeochannel mapping has also been incorporated to reconstruct the ancient fluvial landscape of the Nara Basin.

The historical analysis demonstrates that the present-day Nara Canal occupies, to a considerable extent, the course of an ancient natural channel that has undergone repeated transformations throughout the Holocene. Historical records indicate that sections of this ancient channel remained active during different historical periods before being modified through successive irrigation projects, particularly during the Kalhora, Talpur, and British colonial administrations. The construction of the Sukkur Barrage in the twentieth century fundamentally altered the hydrological character of the basin by converting much of the ancient channel into one of the principal irrigation canals of Sindh.

Archaeological evidence examined in this thesis indicates that the Nara Basin formed an important component of the wider settlement network of the Indus Civilisation. Numerous prehistoric and protohistoric sites distributed along the ancient channel demonstrate long-term human occupation supported by riverine resources, agriculture, pastoralism, and regional trade. Settlement distribution patterns suggest that

environmental stability, water availability, and access to communication routes significantly influenced the development of urban and rural communities throughout different phases of the Indus Civilisation.

The geoarchaeological evidence reviewed in this study indicates that the hydrological history of the Hakra–Ghaggar–Nara system was considerably more complex than earlier linear models suggested. Recent sedimentological investigations, geomorphological analyses, optically stimulated luminescence dating, and provenance studies indicate that river migration, avulsion, monsoon variability, and tectonic adjustments collectively shaped the evolution of the basin over thousands of years. Rather than representing a single permanently flowing river throughout historical time, the fluvial system appears to have experienced multiple phases of activity, seasonal discharge, channel abandonment, and reoccupation.

The long-standing identification of the Ghaggar–Hakra system with the Vedic Saraswati River is critically examined through an evaluation of archaeological, geological, hydrological, and textual evidence. The thesis concludes that, although important correlations exist between certain ancient channels and textual traditions,

the available scientific evidence does not permit a definitive identification of the entire Hakra–Ghaggar–Nara system with the Saraswati described in Vedic literature. Accordingly, interpretations of this relationship should remain grounded in multidisciplinary evidence rather than textual tradition alone.

The research further demonstrates that environmental change constituted a major factor influencing cultural transformation within the basin. Variations in monsoon intensity, river migration, sediment accumulation, tectonic processes, and changing water availability affected agricultural productivity, settlement sustainability, and regional economic networks. These environmental processes contributed to shifts in settlement distribution rather than indicating a sudden or singular collapse of civilisation.

This thesis contributes to existing scholarship in several significant ways. It synthesises historical documentation, archaeological discoveries, geological investigations, and modern geospatial technologies within a single analytical framework. It also provides a comprehensive reassessment of the historical geography of the Nara Basin while highlighting the importance of integrating archaeological science with historical inquiry. The

study offers a balanced evaluation of competing hypotheses concerning ancient river systems and emphasises the necessity of evidence-based interdisciplinary research.

The findings have broader implications for archaeological heritage management, environmental history, historical geography, and future investigations of ancient river systems throughout South Asia. They also demonstrate the importance of protecting the archaeological landscape of the Nara Basin, where many sites remain insufficiently documented and are increasingly threatened by agricultural expansion, modern development, and natural erosion.

Future research should prioritise high-resolution remote sensing, systematic archaeological survey, sediment coring, geochronological analysis, palaeoenvironmental reconstruction, and interdisciplinary collaboration among archaeologists, geologists, hydrologists, geomorphologists, and environmental scientists. Such integrated approaches will further refine our understanding of the evolution of the Nara Basin and its enduring significance within the cultural history of the Indus Civilisation.

Chapter One

Introduction

1.1 Background of the Study

Rivers have played a fundamental role in shaping the geographical, historical, and cultural development of Sindh. The Indus River, one of the great fluvial systems of South Asia, has not only sustained human settlement for millennia but has also profoundly influenced the agricultural economy, political organisation, and cultural evolution of the region through its numerous distributaries, abandoned channels (palaeochannels), floodplains, and irrigation networks. Throughout history, the dynamic behaviour of the Indus and its associated river systems has created a landscape that reflects continuous interaction between natural environmental processes and human adaptation.

Among these ancient fluvial systems, the Nara occupies a distinctive position. It represents a complex hydrological landscape whose significance extends beyond its present function as an irrigation canal. The Nara has attracted sustained scholarly interest because of its geological evolution, historical importance, archaeological potential, and its debated relationship with the Hakra–Ghaggar river system and the broader environmental history of the Indus Civilisation. Consequently, the study of the Nara Basin provides an important opportunity to investigate the long-term interaction between rivers, landscapes, and human societies in eastern Sindh.

Today, the Nara Canal is one of Pakistan's largest and longest irrigation canals. Originating from the Sukkur Barrage, it traverses the districts of Khairpur, Naushahro Feroze, Sanghar, Umerkot, and Tharparkar before irrigating vast areas of eastern Sindh. However, the modern canal represents only the most recent phase in a much longer environmental and historical sequence. Beneath the contemporary irrigation system lies the course of an ancient river channel whose origin, evolution, and historical identity have been the subject of extensive scholarly debate for more than a century.

Historical records, archaeological investigations, geological surveys, and modern geoarchaeological research collectively indicate that the present Nara Canal follows, at least in substantial part, the course of an earlier natural river. The hydrological character of this ancient channel changed repeatedly in response to climatic fluctuations, tectonic movements, sediment accumulation, river avulsion, and human intervention. These long-term transformations produced a complex fluvial landscape that cannot be adequately understood through historical documentation alone but requires the integration of archaeological, geological, hydrological, and environmental evidence.

The Nara Basin is also of exceptional archaeological importance. Numerous prehistoric, Early Harappan, Mature Harappan, Late Harappan, and post-Harappan sites have been identified along the basin, indicating prolonged human occupation over several millennia. The spatial distribution of these settlements suggests that access to water resources, fertile alluvial land, communication routes, and regional exchange networks played a decisive role in shaping patterns of habitation and economic activity. Consequently, the Nara Basin forms an integral component of the wider cultural

landscape of the Indus Civilization rather than representing an isolated geographical entity.

During the colonial period, British administrators, surveyors, and engineers documented the Nara primarily from the perspective of irrigation development and administrative management. Their surveys produced valuable descriptions of the region's topography, ancient channels, seasonal watercourses, and hydraulic potential. Although these accounts remain indispensable historical sources, they were prepared before the emergence of modern geological dating techniques, satellite remote sensing, Geographic Information Systems (GIS), and geoarchaeological methods. Consequently, many of their conclusions require reassessment in light of contemporary scientific evidence.

Over the past three decades, significant advances in geoarchaeology, geomorphology, sedimentology, palaeohydrology, remote sensing, and geochronology have transformed scholarly understanding of ancient river systems across north-western South Asia. High-resolution satellite imagery, Digital Elevation Models (DEMs), Optically Stimulated Luminescence (OSL) dating, isotope hydrology, and Geographic Information Systems now enable researchers to reconstruct abandoned river channels and evaluate their

evolution with a level of precision previously unattainable. These developments have generated new perspectives on the environmental history of the Nara Basin and its relationship with the Hakra–Ghaggar river system and the Indus Civilisation.

Despite this growing body of scholarship, important questions remain unresolved. The origin of the Nara, its chronological relationship with the Hakra and Ghaggar systems, its connection with the debated Saraswati River, the timing of hydrological changes, and the implications of these environmental transformations for settlement history continue to be actively debated. Existing studies often approach these questions from individual disciplinary perspectives, whereas relatively few investigations integrate historical geography, archaeology, geology, hydrology, and environmental science within a single analytical framework.

The present study seeks to address these issues through an interdisciplinary examination of the Nara Basin. By synthesising historical documentation, archaeological evidence, geological investigations, hydrological research, geoarchaeological analyses, and contemporary geospatial technologies, this thesis aims to

provide a comprehensive reconstruction of the historical evolution of the Nara Basin. In doing so, it contributes to a more nuanced understanding of the environmental history of eastern Sindh and offers a critical reassessment of the role of the Nara within the wider cultural and geographical context of the Indus Civilisation.

1.2 Statement of the Research Problem

The existing body of scholarly literature on the Nara Basin is characterised by considerable disagreement regarding its origin, historical development, and hydrological identity. Some researchers regard the present-day Nara as the final course of the ancient Hakra River, whereas others interpret it as one of the eastern distributaries of the Indus River that was subsequently modified through human intervention and transformed into an irrigation canal. At the same time, a number of studies argue that the Hakra, Ghaggar, and Saraswati constituted components of a single major fluvial system, while recent geoarchaeological investigations increasingly support the existence of a complex, multi-channel river system that evolved over time in response to climatic, tectonic, and geomorphological processes.

These divergent interpretations have created significant uncertainty concerning the true origin of the Nara, its historical evolution, its relationship with the Indus Civilisation, and the processes through which it was transformed into the modern Nara Canal. Furthermore, many previous studies have approached these questions from the perspective of a single discipline—whether history, archaeology, geology, or hydrology—without adequately integrating evidence from multiple fields of inquiry.

Although recent advances in geoarchaeology, remote sensing, Geographic Information Systems (GIS), sedimentology, and palaeohydrology have substantially improved our understanding of ancient river systems, their findings have not yet been comprehensively synthesised within a unified framework for the study of the Nara Basin. Consequently, a critical gap remains in the existing scholarship regarding the integration of historical, archaeological, geological, hydrological, and geospatial evidence.

The present study seeks to address this gap by undertaking a comprehensive interdisciplinary investigation of the Nara Basin. It critically evaluates competing hypotheses concerning the origin and evolution of the Nara, reconstructs its historical and hydrological development using

contemporary scientific evidence, and examines its significance within the broader environmental, archaeological, and cultural landscape of the Indus Civilisation. By integrating historical documentation with modern geoarchaeological and geospatial research, this thesis aims to provide a more balanced, evidence-based, and scientifically grounded interpretation of the Nara Basin than has previously been available.

1.3 Research Questions

This study seeks to address the following principal research questions:

1. **How has the geographical and hydrological evolution of the present-day Nara Canal occurred over time?**
2. **Is the modern Nara Canal primarily founded upon the course of an ancient natural river channel (palaeochannel)?**
3. **What historical, geographical, and hydrological relationships exist among the Nara, the Puran, and the Hakra river systems?**
4. **What was the relationship between the settlement patterns of the Indus Civilisation and the Nara Basin?**

5. **What were the principal factors that led to the transformation of the Nara's natural channel into a modern irrigation canal during the British colonial period, and what were the consequences of this transformation?**
6. **To what extent do recent geoarchaeological, geological, hydrological, remote sensing, and Geographic Information Systems (GIS) studies support or challenge earlier interpretations concerning the origin and evolution of the Nara Basin?**
7. **Among the competing scholarly hypotheses concerning the Nara–Hakra–Saraswati system, which interpretation is most consistent with the currently available archaeological, geological, hydrological, and geospatial evidence?**

1.4 Objectives of the Study

1.4.1 General Objective

The principal objective of this study is to examine the geographical evolution, historical development, archaeological significance, and hydrological characteristics of the Nara Basin

through an interdisciplinary analysis integrating historical evidence, archaeological data, and contemporary scientific research.

1.4.2 Specific Objectives

The specific objectives of this research are:

- To examine the natural evolution and historical development of the Nara Basin from prehistoric times to the modern period.
- To critically analyse the historical, geographical, and hydrological relationships among the ancient Puran River, the Hakra River, and the present-day Nara Canal.
- To investigate the spatial distribution, chronological sequence, and archaeological significance of sites located within the Nara Basin.
- To evaluate the relationship between the settlement patterns of the Indus Civilisation and the hydrological system of the Nara Basin.
- To examine the historical development of the Nara Canal, with particular emphasis on the irrigation policies and engineering interventions introduced during the British colonial period.

- To reconstruct the palaeohydrological evolution of the Nara Basin through the integration of satellite imagery, Geographic Information Systems (GIS), sedimentological evidence, geoarchaeological investigations, and other contemporary scientific methods.
- To critically evaluate competing scholarly interpretations concerning the origin, evolution, and historical significance of the Nara Basin in light of recent archaeological, geological, and hydrological evidence.
- To contribute to the broader understanding of the environmental history and historical geography of eastern Sindh by synthesising multidisciplinary evidence within a comprehensive analytical framework.
- To propose future directions for interdisciplinary research and provide recommendations for the conservation, documentation, and sustainable management of the archaeological and cultural heritage of the Nara Basin.

1.5 Research Hypotheses

This study is guided by the following research hypotheses:

H_1: The present-day Nara Canal is largely superimposed upon the course of an ancient natural palaeochannel.

H_2: The historical evolution of the Nara was not exclusively associated with a single distributary of the Indus River; rather, it formed part of a dynamic and multi-channel fluvial system that underwent significant hydrological changes over time.

H_3: The availability of water resources and the presence of an active fluvial system were the principal factors influencing the establishment, development, and spatial distribution of settlements associated with the Indus Civilisation within the Nara Basin.

H_4: The irrigation policies and engineering interventions implemented during the British colonial period transformed ancient natural river channels into components of the modern irrigation network, thereby fundamentally altering the hydrological landscape of the Nara Basin.

H_5: Contemporary geoarchaeological investigations, geological evidence, remote sensing data, and Geographic Information Systems (GIS) analyses provide stronger support for the interpretation of the Hakra–Ghaggar–Nara

system as a dynamic, multi-channel fluvial network than for the traditional hypothesis of a single, perennial Hakra–Saraswati River.

Rationale for the Hypotheses

These hypotheses are formulated on the basis of previous historical studies, archaeological investigations, geological and hydrological research, and recent advances in geoarchaeology and geospatial technologies. They are intended to provide a coherent analytical framework for evaluating the origin, evolution, and historical significance of the Nara Basin through the integration of multidisciplinary evidence. The hypotheses will be systematically examined throughout the thesis using historical documentation, archaeological records, geomorphological observations, sedimentological analyses, satellite imagery, GIS-based spatial analysis, and other relevant scientific data.

1.6 Significance of the Study

This research is significant from historical, archaeological, geoarchaeological, hydrological, environmental, and policy perspectives. By integrating multidisciplinary evidence, it

contributes to a more comprehensive understanding of the Nara Basin and its role within the broader cultural and environmental history of South Asia.

1.6.1 Historical Significance

This study provides a comprehensive reassessment of the historical development of the Nara Basin by synthesising historical records, colonial administrative reports, irrigation documents, and modern scholarly research. It reconstructs the historical evolution of the Nara and its associated river systems, thereby enhancing our understanding of the hydrological and cultural history of eastern Sindh. Furthermore, it offers a critical re-evaluation of long-standing historical interpretations concerning the relationship between the Nara, the Hakra, and other ancient river systems.

1.6.2 Archaeological Significance

The research contributes to the archaeological study of the Nara Basin by examining the relationship between ancient settlements and changing river systems. It analyses the geographical distribution of archaeological sites, settlement patterns, and cultural development within the basin, thereby providing new insights

into the interaction between the Indus Civilisation and its fluvial environment. The study also highlights the archaeological importance of the Nara Basin as an integral component of the wider cultural landscape of the Indus Civilisation.

1.6.3 Geoarchaeological Significance

From a geoarchaeological perspective, this research investigates the combined influence of geological processes, river migration, sediment deposition, climatic fluctuations, and landscape evolution on the historical development of the Nara Basin. By integrating archaeological evidence with geological and geomorphological data, the study contributes to a better understanding of long-term human–environment interactions and the evolution of ancient fluvial landscapes.

1.6.4 Hydrological Significance

This study enhances existing knowledge of the hydrological evolution of the Nara Basin by examining the relationship between ancient natural river systems and the modern irrigation network. It evaluates the transformation of former river channels into the present-day Nara Canal and provides a comprehensive interpretation of the hydrological processes that have shaped the basin over time. The findings also

contribute to broader discussions concerning palaeohydrology and river dynamics in the Lower Indus region.

1.6.5 Environmental Significance

The research contributes to the reconstruction of the environmental history of the Nara Basin by examining the effects of climatic variability, geomorphological processes, sediment accumulation, and river avulsion on landscape evolution and human settlement. Such an interdisciplinary approach improves our understanding of the reciprocal relationship between environmental change and cultural development across the Holocene.

1.6.6 Policy Significance

The findings of this research have practical implications for heritage conservation, environmental management, water-resource planning, and regional development. A more accurate understanding of the historical evolution of the Nara Basin may assist policymakers, heritage authorities, and environmental planners in developing informed strategies for the protection of archaeological sites, sustainable water management, and the preservation of the region's cultural landscape. The study may also

provide a valuable reference for future interdisciplinary research and evidence-based policy formulation relating to the historical and environmental heritage of Sindh.

1.6.7 Academic Contribution

Beyond its regional focus, this study makes a broader academic contribution by integrating historical geography, archaeology, geoarchaeology, hydrology, geomorphology, remote sensing, Geographic Information Systems (GIS), and environmental science within a single analytical framework. It addresses important gaps in existing scholarship and provides a balanced, evidence-based interpretation of the origin and evolution of the Nara Basin. Consequently, the research contributes to ongoing international debates concerning ancient river systems, landscape evolution, and the environmental context of the Indus Civilisation.

1.7 Scope and Delimitations

1.7.1 Scope of the Study

This research examines the historical evolution, geographical characteristics, hydrological

development, and archaeological significance of the Nara Basin through an interdisciplinary analytical framework. The study integrates historical geography, archaeology, geoarchaeology, hydrology, geomorphology, remote sensing, Geographic Information Systems (GIS), sedimentology, and environmental history in order to reconstruct the long-term evolution of the basin and evaluate its significance within the broader context of the Indus Civilisation.

Geographical Scope

The geographical scope of this study encompasses the principal regions associated with the Nara Basin, including:

- Eastern Sindh;
- The entire course of the present-day Nara Canal;
- Khairpur District;
- Sanghar District;
- Umerkot District;
- Tharparkar District;
- The Cholistan Desert;
- Ancient fluvial channels extending towards the Rann of Kachchh.

These areas collectively represent the principal environmental and archaeological landscape

within which the historical evolution of the Nara Basin is investigated.

Thematic Scope

The study addresses the following academic disciplines and research themes:

- Historical Geography;
- Geoarchaeology;
- Hydrology;
- Geomorphology;
- Archaeology;
- Remote Sensing;
- Geographic Information Systems (GIS);
- Sedimentology;
- Palaeohydrology;
- Environmental and Climate History.

The research further examines the interaction between environmental processes and human settlement, with particular emphasis on the influence of river dynamics upon the development of the Indus Civilisation and subsequent historical societies.

1.7.2 Delimitations of the Study

While the study adopts a broad interdisciplinary perspective, several limitations have been

deliberately established in order to maintain a clear analytical focus.

First, the research does not provide a detailed technical evaluation of modern irrigation engineering, hydraulic structures, or contemporary canal management systems. Such issues are considered only insofar as they contribute to an understanding of the historical transformation of the Nara into a modern irrigation canal.

Second, although the Indus River system forms the broader environmental context of this investigation, the primary emphasis is placed upon the Nara Basin and its associated eastern fluvial channels, including their historical, archaeological, and hydrological relationships with the Hakra and Puran river systems.

Third, the chronological scope of the study is largely confined to the Holocene Epoch and the historical period, with particular attention devoted to the prehistoric, Harappan, medieval, colonial, and modern phases of landscape evolution. Earlier geological periods are discussed only where they provide essential background for understanding the formation of the basin.

Finally, this research relies primarily upon historical documents, archaeological evidence, geological investigations, satellite imagery, GIS-based spatial analysis, and published scientific studies. No large-scale archaeological excavation or primary geological field survey was undertaken specifically for this thesis. Consequently, the study synthesises and critically evaluates existing evidence while integrating recent advances in geoarchaeological and geospatial research to produce a comprehensive interpretation of the Nara Basin.

Despite these delimitations, the interdisciplinary nature of the research enables a balanced and comprehensive assessment of the historical geography, environmental evolution, and archaeological significance of the Nara Basin, thereby providing a robust foundation for future scientific investigations.

1.8 Research Methodology

1.8.1 Introduction

The present study adopts an interdisciplinary research methodology to investigate the historical evolution, geographical development,

hydrological characteristics, and archaeological significance of the Nara Basin. Given the complexity of the research problem, reliance upon a single academic discipline would be insufficient to explain the origin, transformation, and cultural significance of the Nara. Accordingly, this study integrates approaches drawn from history, archaeology, geoarchaeology, geomorphology, hydrology, sedimentology, environmental science, remote sensing, and Geographic Information Systems (GIS) in order to construct a comprehensive and scientifically grounded interpretation of the basin.

The interdisciplinary nature of this research enables the correlation of historical documentation with archaeological discoveries, geological evidence, hydrological investigations, and contemporary geospatial technologies. Such an integrated methodological framework facilitates a more reliable reconstruction of ancient river systems, landscape evolution, and human–environment interactions than would be possible through a single disciplinary perspective. This approach also reflects current international trends in archaeological and environmental research, where multidisciplinary evidence is increasingly employed to investigate complex historical landscapes.

The methodological framework has been designed to achieve the research objectives by combining historical inquiry with scientific analysis. Historical records are examined alongside archaeological reports, geological surveys, hydrological studies, satellite imagery, GIS-based spatial analysis, and palaeoenvironmental investigations. Through the systematic integration of these diverse sources of evidence, the study seeks to develop a balanced and evidence-based understanding of the evolution of the Nara Basin.

1.8.2 Research Design

This research is primarily qualitative in nature, employing descriptive, analytical, interpretative, and comparative methods to examine the historical and environmental evolution of the Nara Basin. The principal emphasis is placed upon the critical interpretation of historical documents, archaeological evidence, geological investigations, and geoarchaeological research.

Although qualitative analysis constitutes the core of the investigation, quantitative data have also been incorporated where appropriate. These include spatial information derived from satellite imagery, Geographic Information Systems (GIS),

Digital Elevation Models (DEMs), palaeochannel mapping, sedimentological datasets, and published hydrological measurements. The integration of qualitative interpretation with quantitative spatial analysis strengthens the reliability of the research findings and provides a more comprehensive understanding of landscape evolution.

The research design follows a sequential and interdisciplinary analytical framework comprising the following stages:

1. A comprehensive review of historical, archaeological, geological, and environmental literature relating to the Nara Basin and associated river systems.
2. Collection and critical evaluation of primary historical documents, archaeological excavation reports, geological surveys, and hydrological records.
3. Examination of remote sensing imagery, GIS datasets, and published palaeochannel reconstructions to identify patterns of river migration and landscape change.
4. Comparative analysis of competing scholarly interpretations concerning the Nara, Hakra, Ghaggar, Puran, and Saraswati river systems.

5. Integration of historical, archaeological, geological, hydrological, and geoarchaeological evidence into a unified interpretative framework.

This research design provides a systematic basis for evaluating the historical development of the Nara Basin while ensuring that conclusions are supported by multiple independent sources of evidence rather than by a single category of data.

1.8.3 Sources of Data

To achieve the objectives of this research, data have been collected from a wide range of primary and secondary sources. The integration of documentary, archaeological, geological, hydrological, and geospatial evidence provides a comprehensive foundation for reconstructing the historical and environmental evolution of the Nara Basin.

Primary Sources

The primary sources utilised in this study include:

- British colonial irrigation reports and engineering records relating to the

development of the Nara Canal and associated hydraulic infrastructure.

- Historical maps produced by the Survey of India, depicting the river systems, topography, and administrative boundaries of Sindh and adjacent regions.
- Geological reports published by the Geological Survey of Pakistan and other recognised geological institutions.
- Archaeological reports and excavation records issued by the Department of Archaeology and Museums, Government of Pakistan, and other relevant archaeological organisations.
- Official excavation reports, archaeological survey records, and site inventories relating to the Nara Basin and neighbouring regions.
- Satellite imagery obtained from internationally recognised remote sensing programmes, including Landsat, Sentinel, and other publicly accessible earth observation datasets.
- Geographic Information Systems (GIS) databases, Digital Elevation Models (DEMs), and spatial datasets employed for palaeochannel reconstruction and landscape analysis.
- Historical administrative records, gazetteers, and archival documents

relevant to the hydrological and historical development of the study area.

These primary sources provide first-hand evidence for analysing the historical evolution, archaeological significance, and hydrological characteristics of the Nara Basin.

Secondary Sources

Secondary sources consulted in this research include:

- Peer-reviewed journal articles published in international and regional academic journals.
- Scholarly books on the Indus Civilisation, historical geography, archaeology, geoarchaeology, geology, hydrology, and environmental history.
- Doctoral dissertations and master's theses relevant to the study area and associated research themes.
- British colonial gazetteers and historical administrative publications.
- Published historical documents and translations of classical and medieval texts where relevant.

- Contemporary geoarchaeological, geomorphological, sedimentological, and palaeohydrological studies.
- International scientific journals addressing remote sensing, Geographic Information Systems (GIS), climate history, river dynamics, and environmental archaeology.

The combined use of primary and secondary sources enables the verification of evidence through cross-referencing and contributes to the reliability, objectivity, and scholarly integrity of the research.

1.8.4 Data Collection Methods

Data for this study have been collected through multiple complementary methods consistent with the interdisciplinary nature of the research. The adoption of diverse data collection techniques allows for the integration of historical, archaeological, geological, hydrological, and spatial information within a unified analytical framework.

Literature Review

A comprehensive review of published academic literature was undertaken to establish the theoretical foundation of the research. This included books, peer-reviewed journal articles, conference proceedings, doctoral dissertations, government reports, and other scholarly publications relating to the Nara Basin, the Hakra–Ghaggar system, the Indus Civilisation, geoarchaeology, and historical geography.

Historical Document Analysis

Historical documents, including colonial administrative reports, irrigation records, travellers' accounts, official correspondence, gazetteers, and historical maps, were critically examined to reconstruct the historical development of the Nara Basin and evaluate changing interpretations of its hydrological history.

Comparative Analysis

A comparative analytical approach was employed to evaluate competing scholarly hypotheses concerning the origin and evolution of the Nara, Hakra, Ghaggar, Puran, and Saraswati river systems. Historical evidence was systematically

compared with archaeological discoveries, geological investigations, and recent scientific research in order to identify areas of agreement and disagreement among different interpretations.

Archaeological Interpretation

Published excavation reports, archaeological survey data, settlement distribution maps, and material culture studies were analysed to investigate patterns of human occupation, settlement development, and cultural change within the Nara Basin. Particular attention was devoted to examining the relationship between archaeological sites and ancient river courses.

Geological and Hydrological Data Review

Geological reports, sedimentological investigations, geomorphological studies, and hydrological research were critically reviewed to understand the physical evolution of the basin. These data provide important evidence concerning river migration, sediment deposition, tectonic influences, climatic variability, and the long-term evolution of palaeochannels.

Satellite Image Interpretation

High-resolution satellite imagery obtained from internationally recognised earth observation programmes was examined to identify abandoned river channels, geomorphological features, and landscape changes. Remote sensing techniques provide valuable evidence for reconstructing ancient drainage systems that may no longer be visible at ground level.

GIS-Based Spatial Analysis

Geographic Information Systems (GIS) were employed to integrate archaeological, hydrological, geological, and historical datasets within a single spatial framework. GIS mapping facilitated the analysis of settlement distribution, river migration, palaeochannel reconstruction, and the spatial relationships between environmental and cultural features across the Nara Basin.

The integration of these complementary methods ensures that the research is grounded in multiple independent lines of evidence, thereby enhancing the reliability, validity, and interdisciplinary character of the study.

1.8.5 Data Analysis

The data collected for this study were analysed using a combination of historical, archaeological, geoarchaeological, spatial, and critical analytical methods. The integration of these complementary approaches facilitated a comprehensive interpretation of the historical evolution of the Nara Basin and enabled the evaluation of competing scholarly hypotheses concerning its origin, hydrological development, and archaeological significance.

Historical Analysis

Historical analysis constituted one of the principal analytical approaches adopted in this study. Ancient literary sources, medieval chronicles, indigenous historical accounts, colonial administrative reports, irrigation records, gazetteers, travellers' narratives, and historical maps were systematically examined and critically compared. This analysis enabled the reconstruction of the historical development of the Nara Basin while identifying changes in scholarly interpretations across different historical periods.

Geoarchaeological Analysis

Geoarchaeological analysis was employed to examine the interrelationship between ancient river channels, sedimentary deposits, geomorphological features, and archaeological sites. Particular attention was devoted to evaluating how fluvial processes, landscape evolution, and environmental change influenced human settlement patterns within the Nara Basin. Geological and archaeological evidence was integrated to reconstruct the palaeoenvironmental conditions that prevailed during different phases of occupation.

Spatial Analysis

Spatial analysis was conducted using Geographic Information Systems (GIS), published remote sensing data, palaeochannel maps, and Digital Elevation Models (DEMs). These datasets facilitated the reconstruction of ancient drainage systems, the examination of settlement distribution, and the identification of relationships between archaeological sites and former river courses. Spatial analysis also provided an effective means of comparing historical cartographic evidence with contemporary geospatial data.

Comparative Analysis

A comparative analytical approach was adopted to evaluate the principal scholarly interpretations concerning the Nara, Hakra, Ghaggar, Puran, and Saraswati river systems. Historical, archaeological, geological, hydrological, and geoarchaeological evidence was systematically compared to assess the strengths and limitations of competing hypotheses. This process enabled the identification of areas of scholarly consensus as well as continuing debates within the existing literature.

Critical Analysis

Critical analysis formed the interpretative foundation of the research. Existing theories regarding the origin and evolution of the Nara Basin were examined in light of recent archaeological discoveries, geological investigations, sedimentological studies, remote sensing evidence, and palaeohydrological research. Rather than accepting earlier interpretations uncritically, the study evaluated each hypothesis against the available multidisciplinary evidence in order to develop a balanced and scientifically supported interpretation.

The integration of these analytical approaches ensured that the conclusions of the research were based upon multiple independent sources of evidence rather than any single line of investigation. Such methodological triangulation enhances the reliability, validity, and scholarly credibility of the findings.

1.8.6 Theoretical Framework

This research is grounded in an interdisciplinary theoretical framework that integrates concepts and analytical models from archaeology, historical geography, geomorphology, hydrology, and environmental science. The complexity of the Nara Basin necessitates a theoretical perspective capable of explaining the dynamic interaction between natural processes and human societies over extended periods.

Fluvial Geomorphology

Fluvial Geomorphology provides the principal framework for understanding the evolution of river systems, channel migration, sediment transport, floodplain development, and river avulsion. This approach is fundamental to reconstructing the historical development of the

Nara Basin and interpreting changes in its hydrological characteristics throughout the Holocene.

Landscape Archaeology

Landscape Archaeology examines archaeological sites within their broader environmental and geographical contexts. Rather than viewing settlements as isolated entities, this perspective considers the interaction between human communities and the surrounding landscape. Within this study, Landscape Archaeology provides an essential framework for interpreting settlement distribution, land use, communication routes, and the relationship between archaeological sites and ancient river systems.

Geoarchaeology

Geoarchaeology integrates archaeological evidence with geological and geomorphological investigations to reconstruct ancient landscapes and environmental conditions. This theoretical perspective enables the correlation of archaeological remains with sedimentary sequences, palaeochannels, and geomorphological processes, thereby providing a more comprehensive understanding of long-term

human–environment interactions within the Nara Basin.

Human–Environment Interaction

The concept of Human–Environment Interaction emphasises the reciprocal relationship between environmental processes and human societies. Environmental changes—including climatic variability, river migration, sediment accumulation, and tectonic activity—have profoundly influenced patterns of settlement, agriculture, trade, and cultural development. At the same time, human interventions, particularly irrigation engineering and land-use practices, have significantly modified the natural landscape.

Cultural Ecology

Cultural Ecology examines the adaptive relationship between human societies and their physical environment. This perspective is employed to analyse how communities occupying the Nara Basin responded to changing hydrological conditions through technological innovation, agricultural adaptation, settlement relocation, and water-resource management. The theory provides an important framework for interpreting cultural continuity and transformation within the region.

River Avulsion Theory

River Avulsion Theory explains the natural processes through which rivers periodically abandon existing channels and establish new courses across floodplains. This theoretical model is particularly relevant to the study of the Nara Basin because repeated episodes of channel migration and avulsion appear to have played a significant role in shaping the evolution of the Hakra–Ghaggar–Nara fluvial system. The theory assists in interpreting palaeochannel development and changing patterns of human occupation.

Historical Ecology

Historical Ecology provides an integrative framework for examining the long-term interactions between societies and their environments. It recognises that landscapes are products of both natural processes and cumulative human activities. Within the present study, this perspective facilitates the reconstruction of the environmental history of the Nara Basin while acknowledging the combined influence of climatic change, geomorphological processes, irrigation development, and human adaptation over several millennia.

Integration of the Theoretical Framework

Collectively, these theoretical perspectives provide a comprehensive analytical foundation for interpreting the origin, evolution, and significance of the Nara Basin. The integration of fluvial geomorphology, landscape archaeology, geoarchaeology, human–environment interaction, cultural ecology, river avulsion theory, and historical ecology enables the study to evaluate historical, archaeological, geological, hydrological, and geospatial evidence within a unified interdisciplinary framework. This integrated approach reflects current international scholarship and provides a robust basis for addressing the research questions and testing the hypotheses formulated in this thesis.

1.9 Conceptual Framework

The conceptual framework of this study is founded upon the premise that the Nara Basin represents a dynamic hydrological and cultural landscape that has evolved through the continuous interaction of natural environmental processes and human activities over several millennia. Rather than viewing the present-day Nara Canal as an isolated hydraulic feature, this research conceptualises it as the outcome of long-

term geological, geomorphological, hydrological, archaeological, and historical transformations.

The framework integrates environmental and cultural variables in order to explain the processes through which ancient river systems evolved and influenced patterns of human settlement, agricultural development, and landscape modification. It assumes that climatic fluctuations, tectonic activity, river migration, sediment deposition, and channel avulsion collectively shaped the hydrological evolution of the basin. These natural processes, in turn, influenced human responses, including settlement establishment, agricultural adaptation, trade, water management, and ultimately the construction of engineered irrigation systems.

Accordingly, the present-day Nara Canal is interpreted as the cumulative product of successive natural and anthropogenic transformations rather than the direct continuation of a single, stable river course. This perspective provides an integrated basis for understanding the historical geography of the basin and evaluating competing interpretations regarding its origin and evolution.

The conceptual framework may be illustrated as follows:

Natural Processes

- Climatic variability
- Tectonic movements
- River migration
- Sediment deposition
- River avulsion
- Geomorphological evolution

Hydrological Transformation

- Formation of palaeochannels
- Seasonal and perennial river flow
- Channel migration
- River bifurcation and distributary development
- Floodplain evolution
- Changes in drainage patterns

Human Responses

- Establishment of settlements
- Agricultural expansion
- Water-resource management
- Development of trade and communication networks
- Adaptation to environmental change

Historical Transformation

- Hydraulic developments during the Kalhora period
- Irrigation policies of the Talpur administration
- British colonial irrigation engineering
- Construction of the Sukkur Barrage
- Development of the modern Nara Canal

Present-Day Nara Canal

A modern irrigation system that reflects the cumulative effects of long-term natural processes and sustained human intervention over thousands of years.

Interpretation of the Conceptual Framework

This conceptual framework demonstrates that the historical evolution of the Nara Basin cannot be adequately explained through a single disciplinary perspective. Instead, it emphasises the interconnected nature of environmental change, river dynamics, archaeological development, and historical processes. By integrating evidence from historical geography, archaeology, geoarchaeology, hydrology, geomorphology, remote sensing, and Geographic Information Systems (GIS), the framework provides a coherent analytical model for interpreting the origin,

transformation, and cultural significance of the Nara Basin.

Furthermore, the framework underpins the analytical structure of this thesis by linking the research questions, objectives, hypotheses, methodological approach, and interpretation of evidence within a unified interdisciplinary perspective. It therefore serves as the principal conceptual foundation upon which the subsequent chapters of the thesis are developed.

1.10 Organisation of the Thesis

This thesis is organised into eight substantive chapters, followed by the conclusion, recommendations, appendices, bibliography, glossary, and index. Each chapter addresses a distinct aspect of the research while collectively contributing to a comprehensive understanding of the historical evolution, hydrological development, archaeological significance, and environmental history of the Nara Basin.

Chapter One: Introduction

The first chapter establishes the conceptual and methodological foundation of the research. It

presents the background of the study, the statement of the research problem, research questions, objectives, hypotheses, significance of the study, scope and delimitations, research methodology, theoretical and conceptual frameworks, and the overall organisation of the thesis.

Chapter Two: Review of Literature

The second chapter critically reviews the existing body of scholarly literature relating to the Nara Basin, the Hakra, Ghaggar, Puran, and Saraswati river systems, the Indus Civilisation, and recent geoarchaeological research. It evaluates the principal historical, archaeological, geological, hydrological, and environmental interpretations presented by previous scholars and identifies the major gaps in existing knowledge that this study seeks to address.

Chapter Three: Geographical, Geological, and Hydrological Evolution of the Nara Basin

This chapter examines the geographical setting, geological structure, geomorphological development, and hydrological evolution of the Nara Basin. Particular emphasis is placed on the reconstruction of ancient river courses, the evolution of palaeochannels, environmental

change during the Holocene, and the natural processes that have influenced the development of the basin over time.

Chapter Four: Historical Development of the Nara Basin

The fourth chapter traces the historical evolution of the Nara from antiquity to the modern period. It examines historical references to the river, the development of irrigation systems during the Kalhora and Talpur periods, British colonial hydraulic engineering, and the transformation of the ancient river channel into the modern Nara Canal. Administrative policies, technological developments, and their socio-economic consequences are also critically evaluated.

Chapter Five: Archaeology of the Nara Basin and the Indus Civilisation

This chapter investigates the archaeological significance of the Nara Basin by analysing settlement distribution, material culture, trade networks, and environmental adaptation during the Indus Civilisation and subsequent cultural periods. It explores the relationship between river systems and patterns of human occupation, demonstrating the importance of the Nara Basin

within the wider cultural landscape of the Indus Civilisation.

Chapter Six: Modern Scientific Investigations of the Nara Basin

The sixth chapter reviews contemporary scientific research relating to the Nara Basin, including geoarchaeological investigations, geological studies, sedimentological analyses, hydrological modelling, remote sensing, Geographic Information Systems (GIS), satellite imagery, and palaeoenvironmental reconstruction. The chapter evaluates how these interdisciplinary approaches have transformed current understanding of the basin's historical evolution.

Chapter Seven: Critical Evaluation of the Hakra–Nara–Saraswati Debate

This chapter presents a critical examination of the principal scholarly debates concerning the relationship among the Hakra, Nara, Ghaggar, and the Vedic Saraswati River. Historical sources, archaeological evidence, geological investigations, hydrological studies, and recent geoarchaeological findings are comparatively analysed to assess the validity of competing hypotheses and to develop an integrated interpretative framework based on contemporary scientific evidence.

Chapter Eight: Conclusions and Recommendations

The final chapter synthesises the principal findings of the research and evaluates their contribution to the fields of historical geography, archaeology, geoarchaeology, and environmental history. It revisits the research questions and hypotheses, summarises the major conclusions, discusses the broader academic and practical implications of the study, and presents recommendations for future interdisciplinary research, heritage conservation, water-resource management, and regional planning.

Concluding Sections

Following the main chapters, the thesis includes a series of supplementary sections that enhance its academic value and usability. These comprise:

- **Recommendations**, presenting practical and scholarly suggestions derived from the research findings.
- **Appendices**, containing historical maps, archival documents, archaeological inventories, GIS outputs, remote sensing imagery, geological and hydrological datasets, and other supporting materials.

- **Bibliography**, listing all primary and secondary sources consulted in accordance with the prescribed academic referencing style.
- **Glossary**, providing definitions of specialised archaeological, geological, hydrological, and geographical terminology used throughout the thesis.
- **Index**, enabling efficient access to key subjects, geographical locations, archaeological sites, technical terms, and personal names discussed in the study.

Collectively, these chapters and supporting sections provide a coherent and systematic framework for investigating the historical geography, environmental evolution, and archaeological significance of the Nara Basin. The progression from historical and theoretical foundations to empirical analysis, interdisciplinary interpretation, and final synthesis ensures that the research addresses its objectives comprehensively while contributing original insights to the study of ancient river systems and the cultural landscape of the Indus Civilisation.

Chapter Two

Review of Literature

2.1 Introduction

A rigorous review of the existing body of scholarly literature constitutes the foundation of any sound academic investigation. A literature review not only provides a systematic synthesis of previous research relevant to the subject under investigation but also identifies the principal gaps in current knowledge and demonstrates how the present study seeks to address them. Consequently, it establishes the intellectual context within which the research questions, objectives, and methodological approach of the study are formulated.

The primary purpose of this chapter is to present a critical review of the historical, archaeological, geographical, geological, hydrological, and geoarchaeological scholarship relating to the Nara

Basin, the Hakra and Puran river systems, the ancient fluvial landscapes of eastern Sindh, and their relationship with the Indus Civilisation. Rather than merely summarising previous studies, this chapter evaluates their methodological approaches, evidential bases, principal arguments, and scholarly contributions, while also identifying areas of continuing debate and unresolved questions.

Research concerning the Nara Basin has evolved considerably over the past two centuries. Earlier studies were largely based upon historical narratives, travellers' accounts, colonial administrative records, and irrigation surveys. During the twentieth century, archaeological excavations and historical-geographical investigations significantly enhanced scholarly understanding of the region. More recently, advances in geoarchaeology, geomorphology, sedimentology, remote sensing, Geographic Information Systems (GIS), palaeohydrology, and satellite-based landscape analysis have transformed interpretations of the origin and evolution of the Nara Basin and its relationship with the wider Hakra–Ghaggar fluvial system.

For analytical purposes, the existing scholarship relating to the Nara Basin may be broadly classified into five principal phases:

1. **Ancient and medieval historical sources**, including early geographical descriptions, historical chronicles, and literary references to the river systems of Sindh.
2. **Colonial-era gazetteers, topographical surveys, irrigation reports, and administrative records**, which documented the physical geography, hydrology, and irrigation potential of the Nara region during British rule.
3. **Twentieth-century historical and archaeological investigations**, focusing on the historical geography of Sindh, the Hakra River system, settlement archaeology, and the spatial development of the Indus Civilisation.
4. **Modern interdisciplinary studies of the Indus Civilisation**, integrating archaeology, environmental history, geomorphology, palaeoclimatology, and historical geography to explain patterns of cultural development and environmental change.
5. **Twenty-first-century geoarchaeological, hydrological, remote sensing, GIS-based, and satellite investigations**, which have fundamentally reshaped scholarly understanding of ancient river dynamics, palaeochannel evolution, and the

environmental context of the Indus Civilisation.

These successive phases demonstrate a gradual transition from descriptive historical accounts towards increasingly interdisciplinary and scientifically informed interpretations. While early scholars relied primarily upon documentary and cartographic evidence, contemporary researchers employ a combination of archaeological investigation, geological analysis, geomorphological modelling, remote sensing technologies, geospatial analysis, and palaeoenvironmental reconstruction. This methodological evolution has significantly expanded current knowledge of the Nara Basin, while simultaneously generating new debates concerning its origin, hydrological evolution, and relationship with the Hakra, Ghaggar, and the debated Saraswati River.

The following sections critically examine each of these phases in order to evaluate the development of scholarly thought, identify unresolved research problems, and establish the intellectual foundation upon which the present study is based.

2.2 Ancient and Medieval Historical Sources

2.2.1 Introduction

The earliest understanding of the Nara Basin and the river systems of eastern Sindh is derived from a diverse body of ancient and medieval historical sources. Although these sources do not always refer specifically to the present-day Nara Canal, they contain valuable geographical descriptions of rivers, floodplains, settlements, trade routes, and environmental conditions that contribute significantly to the reconstruction of the historical landscape of the region.

The interpretation of these early records requires careful historical analysis because ancient authors frequently employed different geographical terminologies, and many river courses underwent substantial alterations owing to natural fluvial processes over successive centuries. Consequently, these historical accounts must be critically evaluated alongside archaeological, geological, and hydrological evidence rather than accepted at face value.

2.2.2 Classical Historical Sources

The earliest references to the river systems of the Lower Indus Basin are found in the writings of

Greek and Roman historians and geographers. Accounts associated with the campaigns of Alexander the Great, together with the works of later classical authors such as **Arrian**, **Strabo**, **Pliny the Elder**, and **Ptolemy**, provide important descriptions of the Indus River and its distributaries. Although these writers do not explicitly identify the Nara by its modern name, their observations indicate that eastern Sindh contained an intricate network of river channels, marshes, floodplains, and navigable waterways.

These classical descriptions suggest that the Lower Indus was characterised by frequent channel migration and the existence of multiple distributaries. Such observations are broadly consistent with modern geomorphological interpretations that recognise the dynamic nature of the Indus fluvial system throughout the late Holocene.

Nevertheless, the geographical precision of these classical accounts is often limited. Many descriptions were based upon second-hand information or military observations rather than systematic geographical surveys. Consequently, they should be regarded as valuable historical evidence but interpreted cautiously within the broader framework of multidisciplinary research.

2.2.3 Early Islamic Geographical Sources

A more detailed understanding of the river systems of Sindh emerges from the writings of early Muslim geographers and travellers. Between the ninth and fourteenth centuries CE, several scholars produced valuable descriptions of the physical geography, settlements, agricultural landscapes, and trade routes of Sindh.

Among the most important contributors were **Ibn Khordadbeh**, **Al-Istakhri**, **Ibn Hawqal**, **Al-Muqaddasi**, and **Al-Biruni**, whose works collectively portray Sindh as a region dominated by extensive river networks and highly developed irrigation systems. Their accounts describe fertile agricultural lands sustained by river water and demonstrate the economic importance of fluvial communication for regional commerce.

Although these authors do not always distinguish individual palaeochannels with precision, their descriptions indicate that numerous eastern distributaries of the Indus remained hydrologically significant during the medieval period. Their observations also provide indirect evidence that substantial environmental and hydrological changes had already begun to alter the drainage system of eastern Sindh.

2.2.4 Indigenous Historical Traditions

Indigenous historical traditions preserved in Persian and Sindhi chronicles constitute another important category of evidence. Local historical works record the political history of Sindh alongside valuable information concerning irrigation systems, agricultural development, settlement expansion, and environmental change.

These chronicles frequently associate the prosperity of eastern Sindh with the availability of river water and document repeated efforts by successive administrations to maintain, restore, or modify natural watercourses. Although such narratives often emphasise political events rather than physical geography, they nevertheless preserve significant evidence regarding the historical importance of the Nara and related river systems.

2.2.5 Critical Assessment of Ancient and Medieval Sources

Ancient and medieval historical sources provide indispensable evidence for reconstructing the early environmental history of the Nara Basin. However, they possess important methodological limitations. Their geographical terminology is frequently inconsistent, chronological information

is often imprecise, and many descriptions combine direct observation with hearsay or literary convention.

For these reasons, modern scholarship does not rely exclusively upon historical texts when reconstructing ancient river systems. Instead, documentary evidence is evaluated in conjunction with archaeological discoveries, geomorphological investigations, sedimentological analyses, remote sensing, and Geographic Information Systems (GIS). Such an interdisciplinary approach enables a more reliable reconstruction of the historical evolution of the Nara Basin while reducing the uncertainties inherent in textual evidence alone.

Despite these limitations, ancient and medieval historical sources remain fundamental to understanding the historical geography of eastern Sindh. They provide the earliest documentary record of the region's river systems and establish the historical context within which subsequent archaeological, geological, and hydrological investigations can be interpreted.

2.3 Colonial Scholarship: Gazetteers, Survey Reports, and Irrigation Records

2.3.1 Introduction

The nineteenth and early twentieth centuries marked a significant phase in the study of the Nara Basin. Following the British annexation of Sindh in 1843, systematic surveys of the region were undertaken to document its geography, hydrology, natural resources, agricultural potential, and irrigation systems. Unlike earlier historical accounts, colonial investigations were conducted primarily for administrative, military, and economic purposes. Nevertheless, they produced an extensive body of geographical, geological, and hydrological information that continues to constitute an indispensable source for the study of the historical evolution of the Nara Basin.

British administrators, engineers, surveyors, and geologists prepared detailed reports, maps, gazetteers, and irrigation records that documented the physical characteristics of eastern Sindh, the condition of its ancient river channels, and the development of irrigation infrastructure. Although these studies were often influenced by the priorities of colonial

administration, they remain among the earliest systematic scientific observations of the region.

2.3.2 Gazetteers and Administrative Surveys

Provincial and district gazetteers compiled during the colonial period provide valuable information concerning the geography, climate, agriculture, settlements, river systems, and economic conditions of eastern Sindh. These publications contain detailed descriptions of the Nara, neighbouring river channels, seasonal watercourses, wetlands, and cultivated lands.

The gazetteers also record the gradual transformation of natural river channels into managed irrigation systems. They describe the importance of the Nara as a source of agricultural irrigation and discuss the engineering measures undertaken to regulate water distribution throughout eastern Sindh. Although prepared primarily for administrative purposes, these documents preserve significant historical evidence concerning the changing hydrological landscape of the region.

2.3.3 Survey of India and Topographical Mapping

One of the most important contributions of the colonial period was the production of accurate

topographical maps by the Survey of India. These surveys introduced systematic cartographic techniques that enabled the detailed documentation of river courses, palaeochannels, settlements, elevation, and surface geomorphology.

The maps produced during the nineteenth and early twentieth centuries remain of considerable value because many ancient river channels that were still visible at that time have subsequently been obscured by agricultural development, canal construction, and natural geomorphological change. Modern geoarchaeological investigations frequently compare these historical maps with satellite imagery and Geographic Information Systems (GIS) in order to reconstruct former drainage systems and identify abandoned river courses.

2.3.4 Irrigation Reports and Hydraulic Engineering

Colonial irrigation reports constitute one of the most significant categories of documentary evidence relating to the Nara Basin. British irrigation engineers regarded the Nara as an essential component of the agricultural development of Sindh and undertook extensive

hydraulic engineering works to improve the efficiency of water distribution.

These reports describe the construction, enlargement, and maintenance of canals, regulators, embankments, and distributary networks. They also document seasonal variations in river discharge, sediment accumulation, flood behaviour, and the engineering challenges associated with maintaining irrigation channels in an alluvial environment.

Importantly, many irrigation engineers recognised that substantial sections of the modern Nara Canal followed the course of earlier natural river channels. Their observations have continued to influence subsequent historical and hydrological interpretations concerning the origin of the Nara Basin.

2.3.5 Geological Investigations

Geological observations undertaken during the colonial period significantly enhanced understanding of the geomorphology and sedimentary history of eastern Sindh. British geologists examined alluvial deposits, desert margins, floodplains, and abandoned river channels while attempting to explain the evolution of the region's drainage system.

Although the analytical techniques available at the time were limited, these investigations established the foundation for later studies of river migration, sediment deposition, and palaeochannel development. Many of the geological observations recorded during this period have subsequently been re-evaluated using modern dating techniques, remote sensing technologies, and geoarchaeological methods.

2.3.6 Major Contributions of Colonial Scholarship

Colonial scholarship made several enduring contributions to the study of the Nara Basin:

- It produced the first systematic geographical and hydrological documentation of eastern Sindh.
- It generated detailed topographical maps that continue to serve as important reference sources for archaeological and geomorphological research.
- It documented numerous ancient river channels that were still visible during the nineteenth century.
- It preserved valuable administrative records concerning irrigation management and hydraulic engineering.

- It provided the documentary foundation upon which many subsequent historical and archaeological investigations were built.

These contributions remain of considerable scholarly importance despite the limitations inherent in colonial administrative perspectives.

2.3.7 Critical Evaluation of Colonial Scholarship

While colonial investigations represent an invaluable historical resource, they must be interpreted critically. Most surveys were undertaken to facilitate taxation, irrigation development, transportation, and administrative control rather than to investigate long-term environmental history or archaeological landscapes. Consequently, their interpretations were often shaped by practical colonial priorities.

Furthermore, colonial researchers lacked access to many of the analytical techniques that are now fundamental to geoarchaeological research, including radiometric dating, Optically Stimulated Luminescence (OSL) dating, sediment provenance analysis, high-resolution satellite imagery, Geographic Information Systems (GIS), and Digital Elevation Models (DEMs). As a result, many of their conclusions regarding river evolution, chronology, and palaeochannel development

require reassessment in light of contemporary scientific evidence.

Nevertheless, the descriptive accuracy of many colonial surveys, particularly their cartographic documentation and hydrological observations, has been repeatedly confirmed by subsequent research. Consequently, modern investigations continue to rely upon colonial maps, irrigation reports, and gazetteers as essential historical datasets while interpreting them within an interdisciplinary framework that incorporates archaeological, geological, hydrological, and geoarchaeological evidence.

In summary, colonial scholarship constitutes a crucial stage in the historiography of the Nara Basin. Although constrained by the scientific limitations and administrative priorities of its time, it established the documentary and cartographic foundations upon which subsequent historical, archaeological, and environmental research has been developed.

2.4 Twentieth-Century Historical and Archaeological Research

2.4.1 Introduction

The twentieth century witnessed substantial advances in the study of the Nara Basin, the Hakra River system, and the archaeology of the Indus Civilisation. Unlike the predominantly descriptive investigations of the colonial period, research during this era increasingly adopted systematic archaeological, historical-geographical, and geological approaches. Extensive field surveys, excavations, historical analyses, and regional settlement studies significantly expanded scholarly understanding of the environmental and cultural history of eastern Sindh and the adjoining regions.

The discovery of the Indus Civilisation at Harappa and Mohenjo-daro transformed archaeological research in South Asia and stimulated renewed interest in reconstructing the ancient river systems that had sustained one of the world's earliest urban civilisations. Consequently, the Nara Basin became an important subject of investigation for historians, archaeologists, geographers, and geologists seeking to understand the relationship between river dynamics and human settlement.

2.4.2 Contributions of Sir Marc Aurel Stein

Among the earliest scholars to investigate the ancient river systems of north-western South Asia was **Sir Marc Aurel Stein**, whose extensive archaeological surveys in Bahawalpur and the Cholistan Desert identified numerous abandoned settlements situated along the dry course of the Hakra River. Stein argued that these archaeological remains demonstrated the former existence of a major river that had supported extensive human occupation before gradually drying up.

His meticulous field observations and mapping of archaeological sites provided the first systematic archaeological evidence linking settlement distribution with extinct river channels. Although later geoarchaeological investigations have refined several aspects of his interpretations, Stein's pioneering surveys established the methodological foundation for subsequent archaeological research on the Hakra–Nara system.

2.4.3 Hugh Trevor Lambrick and the Historical Geography of Sindh

The work of **Hugh Trevor Lambrick** represents one of the most influential contributions to the historical geography of Sindh. Through detailed examination of historical records,

geomorphological observations, irrigation history, and regional geography, Lambrick demonstrated that the Indus River had repeatedly altered its course throughout historical time.

In particular, Lambrick argued that the Nara represented an ancient eastern distributary of the Indus River rather than the direct continuation of a single independent river. He emphasised that repeated channel migration, avulsion, sediment accumulation, and changing flood regimes had fundamentally reshaped the hydrological landscape of eastern Sindh over many centuries.

Lambrick's synthesis of historical documentation with physical geography remains a landmark contribution to the study of Sindh's river systems. His work continues to influence debates concerning the historical evolution of the Nara Basin, although some of his conclusions have been reassessed in light of recent geoarchaeological and remote sensing evidence.

2.4.4 Ahmad Hasan Dani and Early Archaeological Investigations

Ahmad Hasan Dani made significant contributions to the archaeology of Pakistan through extensive research on prehistoric cultures, settlement archaeology, and the development of early

civilisations. His studies emphasised the importance of integrating archaeological evidence with environmental and geographical contexts.

Dani recognised that changing river systems played a decisive role in shaping patterns of settlement, communication, and cultural development throughout the Indus region. His interdisciplinary perspective encouraged subsequent researchers to examine archaeological evidence alongside geological and hydrological processes rather than treating cultural development in isolation.

2.4.5 F. A. Khan and the Archaeology of the Indus Civilisation

F. A. Khan contributed substantially to the documentation and interpretation of archaeological sites in Pakistan through numerous excavation projects and regional surveys. His investigations expanded scholarly understanding of settlement distribution, material culture, urban development, and the regional diversity of the Indus Civilisation.

Although his research did not focus exclusively upon the Nara Basin, his findings provided valuable comparative evidence for understanding the environmental setting of Harappan

settlements and their dependence upon river systems and water resources.

2.4.6 M. Rafique Mughal and the Hakra Archaeological Surveys

Among twentieth-century scholars, **Mohammad Rafique Mughal** made one of the most significant contributions to the archaeology of the Hakra River system. His extensive surveys in the Cholistan Desert documented hundreds of archaeological sites distributed along the dry course of the Hakra River, demonstrating that the region had once supported dense patterns of human occupation.

Mughal's chronological classification of settlements provided important evidence for examining changing relationships between river dynamics and cultural development from the Early Harappan through the Late Harappan periods. His work remains one of the most comprehensive archaeological investigations of the Hakra region and continues to serve as a fundamental reference for studies of the Nara–Hakra fluvial landscape.

2.4.7 Interdisciplinary Developments

During the latter half of the twentieth century, increasing collaboration among archaeologists, historians, geologists, geomorphologists, and hydrologists fundamentally transformed research on ancient river systems. Investigations gradually shifted from descriptive historical accounts towards multidisciplinary analyses that combined archaeological evidence with geomorphological observations, sedimentological studies, hydrological modelling, and environmental reconstruction.

This interdisciplinary approach enabled scholars to move beyond the simplistic assumption of a single, stable river course and instead recognise the dynamic and evolving nature of the fluvial landscapes of north-western South Asia.

2.4.8 Critical Evaluation

Twentieth-century scholarship laid the intellectual foundations of contemporary research on the Nara Basin and the Hakra River system. Field surveys, archaeological excavations, and historical-geographical investigations considerably expanded the available evidence and established many of the research questions that continue to shape scholarly debate.

Nevertheless, important limitations remained. Most studies relied upon archaeological observations, historical records, and geomorphological interpretation without access to many of the analytical techniques available today, including Optically Stimulated Luminescence (OSL) dating, high-resolution satellite imagery, Geographic Information Systems (GIS), Digital Elevation Models (DEMs), isotope hydrology, and advanced sediment provenance analysis.

Consequently, while the interpretations advanced by Stein, Lambrick, Dani, Khan, Mughal, and their contemporaries remain of enduring scholarly significance, many of their conclusions have been refined through recent geoarchaeological investigations employing modern scientific methods.

Despite these developments, twentieth-century historical and archaeological research remains indispensable. It established the empirical foundation upon which contemporary interdisciplinary investigations continue to build and played a pivotal role in advancing our understanding of the historical geography, archaeology, and environmental evolution of the Nara Basin and the wider Indus Civilisation.

2.5 Contemporary Geoarchaeological and Scientific Research

2.5.1 Introduction

Since the closing decades of the twentieth century, and particularly during the twenty-first century, research on the Nara Basin and the Hakra–Ghaggar river system has undergone a profound transformation. Advances in geoarchaeology, geomorphology, sedimentology, palaeohydrology, remote sensing, Geographic Information Systems (GIS), satellite imagery, and geochronological dating techniques have significantly enhanced scholarly understanding of ancient fluvial landscapes. These scientific developments have enabled researchers to move beyond interpretations based solely on historical documents and archaeological observations, providing new evidence for reconstructing the evolution of palaeochannels and the environmental history of the Indus Basin.

Contemporary research increasingly recognises that the river systems of north-western South Asia were dynamic rather than static. Repeated episodes of channel migration, avulsion, sediment accumulation, climatic variability, and tectonic

activity have profoundly altered the hydrological landscape over thousands of years. Consequently, the present configuration of the Nara Basin is understood as the product of a long and complex process of environmental transformation.

2.5.2 Geoarchaeological Investigations

Geoarchaeology has become one of the most influential approaches for investigating the historical development of the Nara Basin. By integrating archaeological evidence with geomorphological observations, sedimentological analyses, and geological data, geoarchaeological research reconstructs former landscapes and examines the interaction between environmental change and human settlement.

Recent investigations demonstrate that many archaeological sites within the Indus Civilisation were established adjacent to active river channels that subsequently migrated or became abandoned. This relationship between settlement distribution and fluvial evolution provides valuable evidence for reconstructing the palaeohydrology of eastern Sindh and neighbouring regions.

Furthermore, geoarchaeological studies indicate that no single factor can adequately explain the

evolution of the Nara Basin. Instead, climatic change, sedimentation, tectonic deformation, river avulsion, and human intervention collectively contributed to the transformation of the regional drainage system.

2.5.3 Remote Sensing and Satellite Imagery

Remote sensing has revolutionised the investigation of ancient river systems by enabling researchers to identify palaeochannels that are no longer visible at ground level. High-resolution satellite imagery acquired from Landsat, Sentinel, ASTER, and other Earth observation platforms has revealed numerous buried and abandoned channels across eastern Sindh, Cholistan, Rajasthan, and the Rann of Kachchh.

These datasets have demonstrated that the Nara Basin forms part of a much broader network of former river channels extending across the north-western Indian subcontinent. Satellite imagery has also facilitated the identification of abandoned floodplains, alluvial fans, levees, and geomorphological features associated with former river courses.

Although satellite imagery provides powerful evidence for reconstructing ancient drainage systems, interpretation must be supported by

geological field observations, sedimentological analyses, and archaeological investigations to ensure reliable conclusions.

2.5.4 Geographic Information Systems (GIS)

The application of Geographic Information Systems (GIS) has substantially improved the spatial analysis of archaeological and environmental data. GIS enables researchers to integrate historical maps, satellite imagery, Digital Elevation Models (DEMs), archaeological site inventories, geological information, and hydrological datasets within a unified analytical environment.

Through GIS-based spatial modelling, researchers can reconstruct former river courses, examine settlement distribution, analyse environmental relationships, and evaluate changes in landscape morphology through time. Such techniques have become indispensable for investigating the historical geography of the Nara Basin and for testing competing hypotheses regarding its evolution.

2.5.5 Sedimentology and Geochronology

Modern sedimentological investigations provide direct evidence concerning the depositional

history of ancient river systems. Analyses of sediment composition, grain size, mineral provenance, and stratigraphic sequences enable researchers to distinguish between deposits formed by different river systems and environmental conditions.

Advances in geochronological techniques, particularly Optically Stimulated Luminescence (OSL) dating and radiocarbon dating, have significantly improved the chronological reconstruction of palaeochannels. These methods permit more precise determination of the periods during which ancient river channels remained active or became abandoned.

The application of these techniques has challenged several traditional interpretations that relied exclusively upon historical evidence or surface observations.

2.5.6 Palaeohydrological Reconstruction

Palaeohydrological studies seek to reconstruct the hydrological behaviour of extinct river systems by integrating geological, geomorphological, sedimentological, archaeological, and climatic evidence. Contemporary research indicates that the Hakra–Ghaggar–Nara system experienced repeated fluctuations in river discharge, channel

position, and drainage configuration throughout the Holocene.

Rather than supporting the concept of a single perennial river flowing uninterrupted across the region, many recent investigations suggest a succession of interconnected river channels whose activity varied in response to climatic conditions, tectonic movements, and river avulsion. This interpretation has significantly reshaped current understanding of the environmental context of the Indus Civilisation.

2.5.7 Critical Evaluation

Contemporary scientific research has transformed the study of the Nara Basin by providing multiple independent sources of empirical evidence. The integration of geoarchaeology, geomorphology, sedimentology, remote sensing, GIS, and geochronology has greatly improved the accuracy of palaeochannel reconstruction and environmental interpretation.

Nevertheless, important scholarly debates remain unresolved. Differences persist regarding the chronological sequence of river migration, the hydrological relationship between the Hakra, Ghaggar, and Nara systems, the extent of Himalayan river contributions, and the

identification of the river referred to in Vedic literature as the Saraswati.

Accordingly, current scholarship increasingly favours multidisciplinary investigation rather than reliance upon evidence derived from a single academic discipline. The convergence of archaeological, geological, hydrological, and geospatial data provides the most reliable basis for reconstructing the historical evolution of the Nara Basin.

In summary, contemporary scientific investigations represent the most advanced stage in the historiography of the Nara Basin. They have substantially refined earlier interpretations while opening new avenues for interdisciplinary research into ancient river systems, environmental change, and the historical geography of the Indus Civilisation.

2.6 The Hakra–Ghaggar–Saraswati Debate: A Critical Review of Competing Theories

2.6.1 Introduction

Few subjects in the archaeology and historical geography of South Asia have generated as much

scholarly debate as the identity, origin, and evolution of the Hakra–Ghaggar–Saraswati river system. For more than a century, historians, archaeologists, geologists, hydrologists, geomorphologists, and geoarchaeologists have advanced competing hypotheses concerning the nature of these rivers and their relationship to the Indus Civilisation.

The debate extends beyond questions of physical geography. It encompasses broader issues concerning the environmental context of the Indus Civilisation, the interpretation of Vedic literature, Holocene climatic change, river migration, and the interaction between human societies and dynamic fluvial landscapes. Consequently, the Hakra–Ghaggar–Saraswati question has become one of the most interdisciplinary subjects in South Asian historical and archaeological research.

2.6.2 The Traditional Saraswati Hypothesis

One of the earliest and most influential interpretations identifies the dry channels of the Ghaggar and Hakra with the Saraswati River described in the **Rigveda**. According to this hypothesis, a large perennial river originating in the Himalayas flowed through present-day Haryana, Rajasthan, Cholistan, and eastern Sindh

before ultimately reaching the Rann of Kachchh or the Arabian Sea.

Supporters of this interpretation argue that ancient literary traditions, historical geography, and the concentration of Harappan settlements along the Ghaggar–Hakra corridor collectively indicate the existence of a major river system during the third millennium BCE. They further suggest that the subsequent decline or diversion of this river contributed to environmental changes that affected the urban centres of the Indus Civilisation.

Although this hypothesis has exerted considerable influence upon historical scholarship, many of its earlier formulations were developed before the availability of modern geoarchaeological, sedimentological, and remote sensing evidence.

2.6.3 The Indus Distributary Hypothesis

An alternative interpretation proposes that the Nara and parts of the Hakra system were not the continuation of a single Himalayan river but rather ancient distributaries of the Indus River. According to this view, repeated avulsions of the Indus generated multiple eastern channels at different periods, some of which supplied water to the Nara Basin.

This hypothesis is supported by historical observations, geomorphological evidence, and studies of floodplain evolution demonstrating that the Indus has repeatedly shifted its course throughout the Holocene. Scholars adopting this perspective regard the Nara as an integral component of the Lower Indus fluvial system rather than as the terminal reach of an independent Saraswati River.

2.6.4 The Multi-Channel Fluvial System Hypothesis

Recent geoarchaeological investigations increasingly favour a more complex interpretation in which the Hakra, Ghaggar, Nara, and associated palaeochannels formed parts of an interconnected but evolving network of river systems. Rather than postulating a single stable river, this model suggests that different channels were active during different periods under the combined influence of climatic variability, tectonic activity, sediment accumulation, and river avulsion.

Within this framework, the hydrological history of the region is understood as a sequence of changing drainage configurations rather than the history of one continuous river. Individual channels may have carried water from different

sources—including Himalayan-fed rivers, monsoonal streams, and distributaries of the Indus—at different times during the Holocene.

This interpretation has gained increasing acceptance because it accommodates the diversity of geological, archaeological, hydrological, and geomorphological evidence currently available.

2.6.5 Evidence from Modern Scientific Research

Contemporary investigations employing satellite imagery, Geographic Information Systems (GIS), Digital Elevation Models (DEMs), sediment provenance analysis, Optically Stimulated Luminescence (OSL) dating, radiocarbon dating, isotope hydrology, and geomorphological mapping have significantly reshaped the debate.

Many of these studies indicate that the fluvial history of north-western South Asia cannot be explained by a single, uninterrupted river system. Instead, they demonstrate repeated episodes of channel migration, river capture, avulsion, sediment deposition, and climatic change that produced a highly dynamic hydrological landscape.

Similarly, archaeological investigations reveal that Harappan settlements were established along multiple river channels that varied in age, size, and hydrological characteristics. Settlement continuity therefore appears to have depended upon changing environmental conditions rather than upon a single perennial river.

2.6.6 Critical Evaluation of Competing Theories

Each of the principal hypotheses contributes valuable insights into the historical evolution of the Nara Basin and the wider Hakra–Ghaggar region. The traditional Saraswati hypothesis highlights the importance of ancient literary traditions and historical memory, while the Indus distributary hypothesis emphasises the dynamic behaviour of the Indus River. The contemporary multi-channel model integrates archaeological, geological, hydrological, and geomorphological evidence within a comprehensive scientific framework.

Nevertheless, no single hypothesis provides a complete explanation of all available evidence. Literary traditions, although historically significant, cannot by themselves establish the geological history of ancient river systems. Conversely, geological and hydrological evidence

must also be interpreted within their broader archaeological and historical contexts.

For this reason, the present study adopts an interdisciplinary perspective that evaluates all categories of evidence without privileging any single disciplinary approach. Historical documents, archaeological discoveries, geomorphological observations, sedimentological analyses, remote sensing, GIS-based spatial analysis, and palaeohydrological research are examined collectively to develop a balanced interpretation of the historical evolution of the Nara Basin.

2.6.7 Conclusion

The Hakra–Ghaggar–Saraswati debate remains one of the most significant and intellectually challenging issues in South Asian archaeology and historical geography. Recent scientific advances have shifted scholarly opinion away from simplified models towards increasingly complex reconstructions of ancient fluvial landscapes.

Current evidence suggests that the hydrological history of the region was characterised by repeated environmental change, river migration, channel avulsion, and climatic variability, resulting in the evolution of a dynamic network of interconnected river systems. Consequently, the

Nara Basin is best understood not as the product of a single river tradition but as part of a continuously evolving fluvial landscape shaped by both natural processes and human adaptation over several millennia.

The following chapter builds upon this critical review by examining the geographical, geological, and hydrological evolution of the Nara Basin through the integration of historical, archaeological, geological, and contemporary scientific evidence.

Chapter Three

Geographical, Geological, and Hydrological Evolution of the Nara Basin

3.1 Introduction

A comprehensive understanding of the history and archaeology of the Nara Basin requires a thorough examination of its geographical, geological, and hydrological evolution. The present configuration of any fluvial system is the cumulative outcome of thousands of years of natural processes, including climatic fluctuations, tectonic movements, sediment deposition, river avulsion, and varying degrees of human intervention. Consequently, interpreting the present Nara Canal merely as a modern irrigation channel fails to reflect its complex historical and geomorphological significance.

During the past two decades, remarkable advances in geoarchaeology, remote sensing, Geographic Information Systems (GIS), sedimentology, Optically Stimulated Luminescence (OSL) dating, and isotope hydrology have fundamentally transformed the study of ancient river systems. These interdisciplinary techniques have enabled researchers to identify buried and abandoned palaeochannels, determine their chronological development, reconstruct patterns of water flow, and evaluate long-term environmental changes with unprecedented accuracy.

Recent investigations indicate that the present-day Nara Canal represents the combined outcome of prolonged natural geomorphological evolution and subsequent human engineering. Rather than constituting either an entirely natural river or a wholly artificial canal, the existing system reflects a long history of environmental transformation followed by deliberate hydraulic modification.

3.2 Physical Geography of Sindh

Sindh, situated in the south-eastern part of Pakistan, possesses a physical landscape that has been fundamentally shaped by the Indus River

and its ancient and modern distributary systems. The province is bounded by the Kirthar Range to the west, the Thar Desert to the east, the Arabian Sea to the south, and the extensive alluvial plains of the Indus Basin to the north.

The extensive plains of Sindh were formed through the continuous accumulation of alluvial sediments deposited by the Indus River over hundreds of thousands of years. These deposits produced fertile floodplains, abandoned river channels, natural levees, seasonal depressions, lakes, marshlands, and numerous palaeofluvial features that characterize the region today.

Eastern Sindh, where the Nara Basin is located, occupies a transitional geographical zone between the fertile alluvial plains of the Indus Basin and the arid landscapes of the Thar Desert. This unique geographical position has made the region particularly significant for understanding the evolution of ancient river systems and the development of human settlement throughout prehistoric and historic periods.

3.3 Geographical Setting of the Nara Basin

The Nara Basin extends as a long north–south corridor across eastern Sindh. The modern Nara Canal originates from the Sukkur Barrage and flows southward through the districts of Khairpur, Naushahro Feroze, Sanghar, Umerkot, and Tharparkar before continuing towards the lower parts of Sindh.

From a geographical perspective, the basin exhibits several distinctive characteristics:

- Extensive and nearly level alluvial plains.
- Numerous abandoned palaeochannels.
- Thick accumulations of flood-borne sediments.
- A transitional landscape composed of both aeolian sands and fluvial deposits.
- Hydrological conditions influenced jointly by monsoonal rainfall and seasonal flooding of the Indus River.

These characteristics demonstrate that the Nara Basin should not be regarded solely as a modern irrigation zone but also as an important ancient fluvial landscape that preserves valuable evidence of long-term environmental and hydrological evolution.

3.4 Geological Evolution of Sindh

The present geological framework of Sindh is the product of millions of years of tectonic activity and continuous sediment accumulation within the Indus Basin.

According to the theory of plate tectonics, the northward movement of the Indian Plate and the subsequent uplift of the Himalayan mountain system generated enormous quantities of sediments that were transported into the Indus Basin. Progressive deposition of these sediments ultimately produced the vast alluvial plains that characterize modern Sindh.

During the Holocene Epoch, approximately the last 11,700 years, the Indus River and many of its distributaries repeatedly changed their courses. These episodes of river migration resulted in the formation of numerous palaeochannels, many of which gradually became abandoned and eventually desiccated.

The Nara Basin represents one of these significant palaeofluvial systems. Understanding its evolution therefore requires an integrated investigation combining geology, geomorphology, sedimentology, hydrology, and geoarchaeology.

3.5 Geomorphology of the Nara Region

Geomorphology is the scientific study of landforms and the natural processes responsible for their formation and transformation.

The Nara region exhibits a diverse range of geomorphological features, including:

- Palaeochannels
- Floodplains
- Natural levees
- Meander scars
- Aeolian sand dunes
- Interdunal depressions

Satellite imagery demonstrates that the present course of the Nara Canal corresponds closely with many of these ancient geomorphological features. This correspondence strongly suggests that the modern irrigation canal largely follows the course of an earlier natural river channel that had developed over an extended period of geological history.

3.6 Hydrological Characteristics

The hydrological evolution of the Nara Basin may be understood through three major developmental phases.

Phase I: Natural Fluvial System

During the earliest phase, water reached eastern Sindh through a network of naturally flowing rivers and distributary channels, sustaining extensive wetlands and facilitating the establishment of early human settlements.

Phase II: Progressive Modification of Natural Drainage

Subsequently, climatic fluctuations, sediment accumulation, and repeated river avulsion gradually altered the natural drainage network. As a result, many channels became inactive, while others experienced substantial reductions in water discharge.

Phase III: Modern Irrigation System

The final phase commenced during the colonial period, when British hydraulic engineers transformed portions of the ancient river course into a regulated irrigation canal. This engineering work was further expanded following the construction of the Sukkur Barrage, integrating

the Nara Canal into one of the largest irrigation systems in the world.

Together, these three phases account for the present hydrological configuration of the Nara Basin.

3.7 Interim Conclusions

The preceding discussion demonstrates that the present geographical configuration of the Nara Basin cannot be attributed to a single historical period or to one isolated geological process. Rather, its evolution represents the cumulative outcome of tectonic activity, fluvial dynamics, climatic variability, sediment deposition, and successive phases of human intervention.

Accordingly, the Nara Basin is most appropriately interpreted as a **dynamic fluvial landscape**, reflecting the intertwined evolution of natural environmental processes and human cultural development. Such an interpretation provides a more comprehensive and scientifically robust framework for understanding its geological history, archaeological significance, and role in the broader environmental evolution of the Indus Basin.

3.8 Palaeochannels of the Nara Basin

Palaeochannels are abandoned or buried river courses that were once active but subsequently lost their flow as a consequence of climatic, geological, or hydrological changes. The Nara Basin is regarded as one of the most significant regions in South Asia for the investigation of such ancient fluvial systems.

Recent studies employing satellite imagery, Synthetic Aperture Radar (SAR), Landsat and Sentinel data, Digital Elevation Models (DEMs), and Geographic Information Systems (GIS) have demonstrated that the modern Nara Canal has been constructed largely along the course of an ancient natural river channel. The width of this palaeochannel, together with its sedimentological characteristics and geomorphological features, provides compelling evidence that substantial river flow once occupied this corridor. However, both the magnitude and direction of that flow appear to have varied during different geological periods.

Several researchers have further argued that the Nara Basin did not consist of a single ancient river channel. Instead, it contained a network of

interconnected palaeochannels that were active at different times throughout the Holocene. This evidence indicates that the fluvial landscape of eastern Sindh was dynamic rather than static, undergoing repeated episodes of environmental transformation over thousands of years.

3.9 Hakra–Puran–Nara: An Evolutionary Fluvial System

Various hypotheses have been proposed regarding the relationship between the Hakra, Puran, and Nara river systems. Contemporary interdisciplinary research, however, increasingly suggests that these systems are best understood as components of a dynamic, multi-phase fluvial network rather than as a single, continuously flowing river.

Geographical, geological, and historical evidence indicates that the Ghaggar–Hakra system in the north, the abandoned channels of Cholistan in the central region, and the Puran–Nara drainage system in southern Sindh were interconnected to varying degrees during different periods. Nevertheless, current scientific evidence does not support the hypothesis that one perennial

Himalayan river continuously occupied the same channel for several millennia.

Instead, geological investigations demonstrate that repeated episodes of river avulsion caused channels to migrate, resulting in alternating periods of activity and abandonment. Consequently, the Nara system is more appropriately interpreted as one of the later evolutionary stages of a complex fluvial network whose configuration changed repeatedly through time.

3.10 Holocene Climate Change

The Holocene Epoch, which began approximately 11,700 years ago, represents a critical period in the environmental history of South Asia. Throughout this epoch, substantial variations occurred in monsoon intensity, rainfall distribution, river discharge, and regional landscapes.

Current research indicates that:

- During the Early Holocene, the South Asian monsoon was relatively stronger, producing greater discharge in seasonal river systems.

- During the Middle Holocene, climatic conditions remained comparatively stable, creating favourable conditions for agricultural expansion and the growth of human settlements.
- During the Late Holocene, weakening monsoon activity, declining precipitation, and progressive environmental change reduced the discharge of numerous seasonal rivers and contributed to the abandonment of many fluvial channels.

Modern palaeoclimatic studies emphasize that these transformations occurred gradually over long periods rather than as the result of a single catastrophic event. Accordingly, the evolution of both the Nara and Hakra systems should be understood as a prolonged process of environmental adjustment extending across several millennia.

3.11 River Avulsion

River avulsion is a natural geomorphological process through which a river abandons its former course and establishes a new channel. Such changes may result from sediment accumulation,

alterations in regional gradients, major flooding events, or tectonic activity.

Within the Indus Basin, river avulsion has been a recurrent geological phenomenon. Modern geomorphological research demonstrates that:

- The Indus River has repeatedly altered its course throughout prehistoric and historical times.
- The Sutlej and several other tributaries likewise exhibit clear evidence of channel migration.
- Numerous abandoned channels across eastern Sindh originated through successive episodes of river avulsion.

The present morphology of the Nara Basin most probably developed through multiple phases of such avulsion, after which later irrigation projects reactivated portions of the ancient natural channel for agricultural purposes.

3.12 Sedimentology and Stratigraphy

The sedimentary deposits of the Nara Basin provide essential evidence for reconstructing its palaeohydrological history.

Sedimentological investigations have identified several principal sedimentary facies within the basin, including:

- Fluvial sand
- Silt and clay
- Overbank flood deposits
- Aeolian sand

The stratigraphic succession of these deposits demonstrates that the basin experienced a series of changing environmental conditions. In several locations, fluvial sediments are overlain by aeolian sand deposits, indicating progressive aridification and declining river activity.

Furthermore, recent Optically Stimulated Luminescence (OSL) dating has revealed that the palaeochannels within the basin are not contemporaneous. Their differing ages indicate that the region experienced repeated episodes of fluvial activity during various phases of the Holocene rather than remaining continuously active throughout a single period.

3.13 Chronology of Geomorphological Evolution

Based on the currently available geological, geomorphological, and geoarchaeological evidence, the evolution of the Nara Basin may be divided into five principal stages.

Phase I: Early Holocene

Relatively humid climatic conditions prevailed, allowing numerous natural river channels to remain active throughout eastern Sindh.

Phase II: Middle Holocene

Favourable environmental conditions promoted agricultural expansion, while settlements developed along the banks of active river systems.

Phase III: Late Holocene

Declining monsoon intensity, river avulsion, and continued sediment accumulation caused many fluvial channels to become progressively inactive.

Phase IV: Historical Period

Ancient natural channels continued to receive seasonal floodwaters from the Indus River and were partially utilized through indigenous irrigation systems developed by local communities.

Phase V: Colonial and Modern Period

During the British colonial period, the ancient natural channel was transformed into the regulated Nara Canal, which subsequently became an integral component of the Sukkur Barrage irrigation network.

3.14 Critical Analysis

Contemporary geoarchaeological research clearly demonstrates that the traditional interpretations of the Nara Basin are no longer entirely satisfactory. Neither the hypothesis of a single perennial river flowing continuously through the same channel nor the view that the Nara is merely an artificial irrigation canal adequately explains the available scientific evidence.

A more balanced interpretation recognizes the Nara as a hydrological system established upon an ancient natural palaeochannel that remained active to varying degrees during different periods before being systematically modified through human hydraulic engineering. This interpretation is more consistent with the combined evidence derived from archaeology, geology,

geomorphology, sedimentology, remote sensing, and palaeohydrology.

3.15 Interim Conclusion

The evidence presented in this section demonstrates that the present form of the Nara Basin is the cumulative product of long-term geological evolution, Holocene climatic change, river avulsion, sediment deposition, and successive phases of human intervention. Consequently, it is scientifically inadequate to describe the Nara solely as either a modern irrigation canal or an ancient river.

Instead, it should be understood as a complex, multi-phase, and dynamic fluvial landscape whose present morphology reflects the interaction of natural environmental processes and human modification over thousands of years.

3.16 Remote Sensing and GIS Analysis of the Nara Basin

3.16.1 Introduction

During the past two decades, Remote Sensing and Geographic Information Systems (GIS) have become indispensable tools in the investigation of ancient fluvial landscapes. These advanced technologies have enabled researchers to identify palaeochannels that are no longer visible on the ground surface, thereby providing new insights into the evolution of prehistoric river systems.

Recent studies of the Nara Basin have employed Landsat imagery, Sentinel-2 data, ASTER imagery, the Shuttle Radar Topography Mission (SRTM), Synthetic Aperture Radar (SAR), and high-resolution Digital Elevation Models (DEMs). Collectively, these datasets have facilitated the identification of ancient river courses, sedimentary deposits, topographic features, and geomorphological structures that are essential for reconstructing the palaeohydrology of eastern Sindh.

3.16.2 Evidence from Satellite Imagery

Analysis of satellite imagery reveals numerous elongated, sinuous, and interconnected palaeochannels across eastern Sindh. These ancient channels correspond closely with the alignment of the present-day Nara Canal.

Satellite observations indicate that:

- Much of the modern Nara Canal follows the course of a pre-existing natural palaeochannel.
- Eastern Sindh contains numerous parallel and branching abandoned river channels.
- Many archaeological sites are situated adjacent to these former river courses.
- Distinct boundaries between fluvial deposits and aeolian sand can be identified in several areas.

These observations strongly suggest that the present landscape of the Nara Basin is the product of prolonged natural geomorphological evolution rather than recent engineering alone.

3.16.3 GIS-Based Geographical Analysis

GIS technology has enabled the integrated analysis of ancient river systems, topography, sediment distribution, archaeological sites, hydrological patterns, and land use.

GIS-based investigations demonstrate that:

- Ancient river channels within the Nara Basin closely follow the natural regional gradient.

- Prehistoric settlements were concentrated near reliable water sources.
- The spatial distribution of numerous Indus Civilization sites corresponds closely with identified palaeochannels.
- Agricultural occupation during later historical periods likewise remained concentrated along these ancient fluvial corridors.

GIS analysis further indicates that British engineers, during the colonial period, deliberately utilized much of the pre-existing natural river course when designing the modern Nara Canal.

3.17 Optically Stimulated Luminescence (OSL) Dating

Optically Stimulated Luminescence (OSL) dating has become one of the most significant analytical techniques in modern geoarchaeology. The method determines the length of time since sediment grains were last exposed to sunlight, thereby establishing the depositional age of fluvial and aeolian sediments.

Studies conducted on sediments associated with the Nara and Hakra systems have produced several important findings:

- Individual palaeochannels differ significantly in age.
- Some channels date to the Early Holocene.
- Others remained active during the Middle or Late Holocene.
- Different river channels transported water during different periods rather than functioning simultaneously.

These findings clearly demonstrate that the evolution of the Nara Basin was a prolonged, multi-phase process rather than the result of a single hydrological episode.

3.18 Isotope Hydrology

Isotope hydrology provides valuable information concerning the origin, movement, and environmental history of ancient water systems.

Recent isotopic investigations indicate that:

- Water sources supplying individual palaeochannels were not uniform.

- Certain sectors of the basin depended primarily upon seasonal monsoonal precipitation.
- Himalayan-derived water reached different parts of the basin during different periods.
- The chemical composition of groundwater preserves important evidence concerning the evolution of the ancient fluvial system.

These results further emphasize the complexity of the palaeohydrological history of the Nara Basin and demonstrate that multiple water sources contributed to its evolution over time.

3.19 A Geoarchaeological Model of the Nara Basin

On the basis of currently available geological, archaeological, geomorphological, and hydrological evidence, the evolution of the Nara Basin may be interpreted through the following geoarchaeological model.

Phase I: Natural Fluvial Activity

During the Early Holocene, several natural river channels traversed eastern Sindh, providing

favourable environmental conditions for the establishment of early human communities.

Phase II: Agricultural Expansion

During the Middle Holocene, relatively stable climatic conditions encouraged agricultural intensification, leading to the growth of settlements along active river courses.

Phase III: Environmental Transformation

Progressive weakening of the South Asian monsoon, continued sediment accumulation, and repeated river avulsion gradually reduced the activity of many natural channels, resulting in widespread channel abandonment.

Phase IV: Historical Irrigation

Subsequent historical societies sought to utilize sections of these abandoned natural channels for irrigation purposes, leading to the partial reoccupation and agricultural development of several areas.

Phase V: The Modern Nara Canal

During the British colonial period, extensive hydraulic engineering transformed the ancient natural channel into the regulated Nara Canal.

Following the construction of the Sukkur Barrage, this canal became an integral component of the modern irrigation network of Sindh.

3.20 Comparative Evaluation of Scholarly Interpretations

A critical review of contemporary scholarship demonstrates that interpretations concerning the origin and evolution of the Nara Basin may be grouped into three principal schools of thought.

The first school argues that the Nara represents the southern continuation of the Hakra or Ghaggar–Hakra river system. Proponents of this hypothesis rely primarily upon historical geography, selected geological evidence, and traditional historical accounts.

The second school interprets the Nara principally as an eastern distributary of the Indus River or as a natural flood channel periodically reactivated by seasonal inundation. According to this interpretation, repeated Indus floods rejuvenated older abandoned channels during different historical periods.

The third and increasingly influential interdisciplinary interpretation proposes that the Nara was not a single river but rather a dynamic hydrological system composed of numerous palaeochannels and local watercourses that became active at different times. This model integrates evidence from archaeology, sedimentology, remote sensing, OSL dating, geomorphology, and hydrology, and is currently regarded as the most comprehensive explanation of the basin's complex environmental history.

3.21 Summary of Chapter Three

This chapter has presented a comprehensive examination of the geographical, geological, and hydrological evolution of the Nara Basin. Evidence derived from geoarchaeology, remote sensing, GIS, OSL dating, sedimentology, isotope hydrology, and geomorphological investigations demonstrates that the Nara represents a complex, multi-phase fluvial system rather than a simple river channel or an exclusively artificial canal.

The modern Nara Canal occupies an ancient natural palaeochannel that remained associated with fluvial processes during different periods before being systematically modified through

successive irrigation projects. Consequently, the present configuration of the basin reflects the combined effects of long-term natural evolution and deliberate human hydraulic engineering.

The analysis further demonstrates that describing the Nara solely as the Hakra River, merely as a distributary of the Indus, or simply as a modern irrigation canal fails to capture its full historical and environmental complexity. A more scientifically robust interpretation recognizes the basin as a **Dynamic Fluvial Landscape** and an integrated **Geoarchaeological System**.

3.22 Conclusion of Chapter Three

The evidence examined throughout this chapter demonstrates that the evolution of the Nara Basin resulted from a prolonged interaction between geological processes, environmental change, climatic variability, and human intervention. Contemporary scientific research underscores the necessity of reassessing traditional interpretations within a broader interdisciplinary framework.

By integrating evidence from history, archaeology, geology, geomorphology, hydrology, geoarchaeology, sedimentology, remote sensing,

and palaeoenvironmental studies, a more comprehensive reconstruction of the history of the Nara Basin becomes possible.

The conclusions reached in this chapter provide the essential foundation for the next chapter, which examines the archaeology of the Nara Basin, the distribution of Indus Civilization settlements, patterns of human occupation, trade networks, agricultural development, and the broader cultural evolution of the region.

Chapter Four

Archaeology of the Nara Basin and the Indus Civilization

4.1 Introduction

The archaeology of the Nara Basin occupies a position of fundamental importance in understanding the eastern territorial expansion of the Indus Civilization (Indus Valley Civilization). Recent archaeological and geoarchaeological investigations demonstrate that the cities, towns, and villages of the Indus Civilization were not distributed randomly across the landscape. Rather, they were systematically established in close association with river systems, palaeochannels, floodplains, and reliable sources of water.

The Nara Basin is particularly significant because it preserves a distinctive archaeological continuum linking ancient river channels, the margins of the Thar Desert, and long-standing agricultural settlements. Recent geoarchaeological

investigations employing remote sensing, Geographic Information Systems (GIS), satellite imagery, and sedimentological analyses have revealed that numerous Harappan sites are situated adjacent to buried or abandoned palaeochannels that now form part of the Nara Basin.

These discoveries have fundamentally transformed previous interpretations of eastern Sindh by demonstrating that the region constituted an integral component of the broader Indus Civilization rather than a peripheral or isolated frontier. Consequently, the archaeological landscape of the Nara Basin provides valuable evidence for reconstructing patterns of settlement, environmental adaptation, economic organization, and cultural development within the eastern sector of the Indus Civilization.

4.2 Eastern Frontier of the Indus Civilization

Contemporary scholarship generally recognizes that the Indus Civilization was not confined to a limited geographical area but instead constituted a vast, environmentally diverse, and multi-nodal cultural system extending across much of northwestern South Asia.

Within this broader framework, the Nara Basin represented one of the principal eastern frontier zones of the civilization. Archaeological and environmental evidence indicates that:

- Agricultural communities were established in close proximity to ancient river channels.
- Trade routes generally followed natural drainage systems and fluvial corridors.
- Small rural settlements maintained close economic and administrative relationships with larger urban centres.
- Seasonal water availability constituted the principal factor governing patterns of settlement and agricultural production.

Floodplain agriculture formed the economic foundation of the eastern sector of the Indus Civilization. Periodic flooding enriched agricultural soils through the deposition of fertile alluvium, thereby supporting sustained cultivation and the growth of permanent settlements. Consequently, the environmental history of the Nara Basin is inseparable from the cultural and economic history of its inhabitants.

4.3 Major Archaeological Sites of the Nara Basin

Recent archaeological surveys and published investigations have identified numerous archaeological sites throughout the Nara Basin representing several chronological phases of occupation. Collectively, these sites demonstrate prolonged human settlement extending from the pre-Harappan period through the historical era.

4.3.1 Harappan Sites

Numerous settlements belonging to the Harappan period have been identified within the Nara Basin. Excavations and surface surveys have recovered pottery, mud and baked bricks, lithic implements, agricultural tools, and other cultural materials characteristic of the Indus Civilization.

The spatial distribution of these settlements clearly indicates that human occupation was closely associated with dependable water resources. The concentration of Harappan sites along palaeochannels strongly suggests that ancient river systems played a decisive role in determining settlement location, agricultural productivity, and economic sustainability.

4.3.2 Pre-Harappan Sites

Several locations within the basin have yielded cultural materials predating the Mature Harappan

period. These early settlements contain evidence of agricultural communities whose subsistence strategies were similarly adapted to fluvial environments.

The existence of these pre-Harappan occupations demonstrates that eastern Sindh supported organized human settlement long before the emergence of the urban Indus Civilization. Rather than representing a newly colonized landscape, the region experienced gradual cultural development that ultimately contributed to the rise of Harappan urbanism.

4.3.3 Post-Harappan and Historical Sites

The decline of the Indus Civilization did not result in the complete abandonment of the Nara Basin. Archaeological evidence indicates that several settlements continued to be occupied during subsequent historical periods.

These later occupations are frequently associated with localized irrigation systems and agricultural communities that adapted to changing environmental conditions. Such evidence reflects continuity in human occupation despite significant transformations in regional hydrology and settlement organization.

4.4 Relationship between Palaeochannels and Settlement

Recent archaeological investigations clearly demonstrate that the spatial distribution of archaeological sites within the Nara Basin is highly systematic rather than random. Their geographical pattern corresponds closely with the locations of ancient palaeochannels.

Analyses based upon GIS and remote sensing indicate that:

- The majority of Harappan settlements are located along the margins of palaeochannels.
- Reliable access to water constituted the principal determinant of settlement location.
- Population centres shifted in response to changes in river courses.
- Several settlements experienced repeated cycles of occupation, abandonment, and reoccupation.

This settlement pattern strongly supports the interpretation of the Indus Civilization as a **river-dependent civilization**, whose economic

organization, agricultural productivity, and urban development were fundamentally structured by fluvial systems and water availability.

4.5 Trade and Communication Networks

The Nara Basin functioned not only as an agricultural region but also as an important corridor for transportation, communication, and regional commerce.

Current archaeological evidence suggests that:

- Ancient river channels provided natural routes for transportation and trade.
- Local settlements maintained regular interaction with other centres of the Indus Civilization.
- Economic and cultural connections existed between eastern Sindh, the Thar Desert, and Cholistan.
- Raw materials were exchanged through regional trade networks extending across the civilization.

These observations demonstrate that the Nara Basin formed part of an integrated economic system linking agricultural production, craft

specialization, resource procurement, and long-distance exchange. Rather than existing in isolation, eastern Sindh participated actively in the wider commercial networks of the Indus Civilization.

4.6 Cultural Continuity

The archaeological record of the Nara Basin preserves abundant evidence of long-term cultural continuity extending across multiple historical periods.

Important indicators of this continuity include:

- Persistent ceramic traditions.
- Progressive development of agricultural implements.
- Continued evolution of irrigation technology.
- Long-term stability in regional settlement distribution.

These patterns demonstrate that human occupation within the basin was not interrupted entirely following the decline of the Indus Civilization. Instead, cultural traditions were gradually transformed while maintaining

significant elements of continuity, reflecting long-term adaptation to changing environmental and socio-economic conditions.

4.7 Modern Archaeological Interpretation

Contemporary archaeology no longer interprets the Nara Basin as a static historical landscape. Instead, it is increasingly understood as a **Dynamic Cultural Landscape**, shaped by the continuous interaction of environmental processes and human societies.

According to this perspective:

- Civilizations evolve in close association with river systems.
- Human settlements continually adapt to environmental change.
- Cultural transformations are generally gradual rather than abrupt.
- Fluvial systems exert a fundamental influence upon the spatial organization and long-term development of civilizations.

Geoarchaeology provides the principal theoretical framework for this interpretation by integrating archaeological evidence with geomorphology,

geology, hydrology, palaeoenvironmental reconstruction, and remote sensing. This interdisciplinary approach enables a more comprehensive understanding of the complex relationships between environmental change and human cultural evolution.

4.8 Chapter Summary

This chapter has presented a comprehensive review of the archaeology of the Nara Basin within the broader context of the Indus Civilization. The available archaeological, geoarchaeological, and environmental evidence demonstrates that the basin constituted an important component of the eastern sector of the civilization, where patterns of human settlement were fundamentally structured by ancient river systems.

The spatial distribution of archaeological sites, their close association with palaeochannels, the existence of regional trade networks, and the evidence for long-term cultural continuity collectively indicate that the Nara Basin represented an active, dynamic, and environmentally responsive cultural landscape. These findings significantly enhance our

understanding of the eastern expansion and regional diversity of the Indus Civilization.

4.9 Conclusion

The archaeological evidence from the Nara Basin demonstrates that the Indus Civilization extended well beyond its major urban centres. The eastern regions of the civilization formed an organized cultural landscape characterized by environmental adaptation, systematic settlement planning, and close dependence upon ancient fluvial systems.

Recent interdisciplinary research has re-established the Nara Basin as one of the most significant yet comparatively understudied regions of the Indus Civilization. Continued archaeological excavation, geoarchaeological investigation, remote sensing, and environmental reconstruction are expected to provide further insights into the cultural history, settlement dynamics, and environmental evolution of this important archaeological landscape.

Major Archaeological Sites of the Nara Basin: A Critical Review

4.10.1 Introduction

A comprehensive understanding of the archaeology of the Nara Basin requires more than the examination of individual archaeological sites. Equally important is an integrated analysis of their geographical distribution, their relationship with ancient palaeochannels, their material culture, and their chronological development. Recent archaeological and geoarchaeological research indicates that numerous sites in eastern Sindh formed part of an organized settlement system closely associated with water availability, agricultural production, and regional exchange networks.

Rather than representing isolated communities, these settlements constituted interconnected components of a broader cultural landscape that evolved in response to changing environmental

and hydrological conditions. Consequently, the archaeological record of the Nara Basin provides important evidence for reconstructing the settlement dynamics of the eastern Indus Civilization.

4.10.2 Geographical Distribution of Archaeological Sites

The archaeological sites of the Nara Basin exhibit a distinct geographical pattern characterized by several recurring environmental features.

These include:

- Settlement along the margins of ancient palaeochannels.
- Permanent occupation on elevated natural levees.
- Agricultural activities concentrated adjacent to floodplains.
- Trading centres situated near the margins of the Thar Desert.

The distribution of these settlements demonstrates that their locations were determined neither randomly nor opportunistically. Instead, settlement selection

reflects a sophisticated understanding of local environmental conditions, particularly the availability of water, fertile agricultural land, and communication routes.

This spatial organization illustrates the close interaction between human occupation and the dynamic fluvial environment of eastern Sindh.

4.10.3 Settlement Hierarchy

Archaeological evidence suggests that the settlements of the Nara Basin may be classified into three principal categories.

(a) Major Settlement Centres

These large settlements functioned as administrative, economic, and commercial centres. Archaeological remains include standardized baked bricks, planned architectural layouts, storage facilities, workshops, and evidence of specialized craft production.

Their scale and material remains indicate that they performed important regional functions within the broader settlement hierarchy of the Indus Civilization.

(b) Intermediate Settlements

Medium-sized settlements served as centres of agricultural production, local commerce, and regional interaction. Their archaeological assemblages demonstrate that organized relationships existed between major urban centres and smaller rural communities.

These settlements probably acted as intermediaries in the movement of agricultural products, manufactured goods, and information throughout the region.

(c) Small Agricultural Villages

The smallest settlements were primarily agrarian communities dependent upon cultivation, animal husbandry, and the exploitation of local natural resources.

Most of these villages relied upon seasonal water supplies derived from nearby river channels or floodplains, illustrating the close relationship between settlement sustainability and environmental conditions.

Collectively, these three settlement categories reflect a well-developed regional hierarchy

comparable to that documented elsewhere within the Indus Civilization.

4.10.4 Material Culture

The archaeological materials recovered from the Nara Basin exhibit strong similarities to those discovered at other Indus Civilization sites, confirming the region's participation in a shared cultural tradition.

Ceramics

Ceramic assemblages include:

- Standardized red ware.
- Black-painted geometric decorative motifs.
- Storage jars, cooking vessels, and domestic pottery.
- Gradual technological developments in ceramic manufacture through successive chronological phases.

Comparative ceramic analysis demonstrates that the potters of the Nara Basin participated fully in the broader technological and artistic traditions of the Indus Civilization.

Bricks

Architectural remains reveal the use of:

- Standardized baked bricks.
- Sun-dried mud bricks.
- Different brick types employed for residential, public, and defensive structures.

The standardized proportions of bricks correspond closely with construction practices observed at major Harappan urban centres, indicating the widespread application of common architectural principles.

Stone Tools

Recovered lithic assemblages include:

- Flint implements.
- Cutting and drilling tools.
- Stone agricultural implements.

These artifacts indicate both local production and participation in wider exchange networks supplying high-quality lithic raw materials.

Ornaments and Personal Adornment

Archaeological excavations have also recovered:

- Agate beads.
- Carnelian ornaments.
- Shell ornaments.
- Limited quantities of copper and bronze artifacts.

The presence of these materials indicates that the Nara Basin maintained commercial connections with distant resource areas and participated in extensive interregional trade networks extending across the Indus Civilization.

4.10.5 Cholistan–Nara Archaeological Connections

Numerous archaeological similarities exist between the Cholistan region and the Nara Basin.

These include:

- Comparable ceramic traditions.
- Similar geographical patterns of settlement.
- Close association with ancient river channels.
- Agricultural economies dominated by floodplain cultivation.
- Possible correspondence between regional trade routes.

Modern archaeological research increasingly indicates that Cholistan and eastern Sindh did not represent separate cultural spheres. Instead, both regions formed integral components of a broader regional civilization connected through environmental adaptation, economic interaction, and cultural exchange.

These observations reinforce the interpretation of the eastern Indus Civilization as a highly integrated cultural landscape extending across multiple ecological zones.

4.10.6 Chronology

Archaeological investigations identify several major cultural phases within the Nara Basin.

Pre-Harappan Period

Characterized by early agricultural settlements, locally produced ceramics, and small village communities.

Early Harappan Period

Marked by population growth, technological development, expanding craft production, and the emergence of organized regional exchange.

Mature Harappan Period

Represented by urban planning, standardized architecture, long-distance commerce, economic specialization, and administrative integration.

Late Harappan Period

Characterized by the decline of certain settlements, changing patterns of occupation, and increasing regional cultural diversity.

This chronological sequence demonstrates that the Nara Basin participated actively throughout the developmental history of the Indus Civilization rather than representing a marginal or peripheral region.

4.10.7 Modern Dating Techniques

Recent archaeological investigations of the Nara Basin employ several complementary chronological methods, including:

- Radiocarbon Dating (^{14}C)
- Optically Stimulated Luminescence (OSL)
- Ceramic Typology
- Stratigraphic Correlation

The combined application of these methods has demonstrated that individual archaeological sites were occupied during different chronological periods. Consequently, the cultural history of the basin cannot be interpreted as representing a single phase of occupation but instead reflects multiple episodes of settlement extending across several millennia.

4.10.8 Critical Analysis

Several important conclusions emerge from the archaeological evidence presently available for the Nara Basin.

First, settlement distribution was fundamentally determined by access to water resources and favourable environmental conditions.

Second, the material culture recovered from the region confirms its close integration within the broader cultural tradition of the Indus Civilization.

Third, archaeological evidence demonstrates sustained cultural, economic, and commercial interaction between eastern Sindh and the Cholistan region.

Fourth, advances in geoarchaeology, modern dating techniques, remote sensing, and interdisciplinary research have significantly strengthened the scientific evaluation of earlier archaeological interpretations.

Nevertheless, many archaeological sites within the Nara Basin remain insufficiently investigated. Comprehensive excavation, high-resolution spatial mapping, geoarchaeological analysis, palaeoenvironmental reconstruction, and multidisciplinary field research remain essential for achieving a more complete understanding of the region's archaeological history.

Future investigations are therefore expected to produce substantially more refined interpretations of settlement organization, environmental adaptation, and cultural evolution within the eastern sector of the Indus Civilization.

4.10.9 Interim Conclusion

The evidence presented in this section demonstrates that the Nara Basin constituted one of the principal archaeological landscapes of the eastern Indus Civilization. Large urban centres, intermediate settlements, agricultural villages,

regional trade routes, and extensive cultural interactions collectively formed an organized settlement system closely adapted to its fluvial environment.

The combined evidence from archaeology, geoarchaeology, geomorphology, palaeohydrology, remote sensing, and modern chronological studies strongly supports the conclusion that the Nara Basin should be regarded as a central component of the eastern Indus Civilization. Continued interdisciplinary research will undoubtedly refine our understanding of its role in the development, expansion, and long-term evolution of one of the world's earliest urban civilizations.

4.11 Introduction

Within the study of the Indus Civilization, **site-based archaeology** occupies a position of fundamental importance. Each archaeological site possesses distinctive characteristics in terms of its geographical setting, cultural sequence, economic activities, architectural traditions, and environmental context. Consequently, a comprehensive understanding of the Nara Basin cannot be achieved solely through regional

overviews; rather, it requires detailed scientific examination of each major archaeological site. Such an approach provides a more accurate reconstruction of the cultural evolution, settlement organization, and environmental adaptation of the region.

4.12 Kot Diji

Geographical Setting

Kot Diji is located in the Khairpur District of Sindh, on the eastern side of the Indus River. Although the site is not situated directly along the present course of the Nara Canal, it occupies a pivotal position in understanding the ancient fluvial systems of eastern Sindh and the broader archaeological landscape of the Nara Basin.

Discovery and Excavation

Scientific excavations were conducted by **F. A. Khan** between **1955 and 1957**, leading to the identification of a well-developed cultural phase that predated the Mature Harappan Civilization. This cultural horizon subsequently became known as the **Kot Diji Culture**, representing one of the earliest urban traditions in the Indus region.

Cultural Significance

Excavations at Kot Diji demonstrate that:

- Organized urban life existed before the Mature Harappan Period.
- Fortification walls had already been constructed during the Early Harappan phase.
- Ceramic production had attained a high level of technological sophistication.
- Agricultural production had developed into a well-organized economic system.

Relationship with the Nara Basin

Kot Diji provides compelling evidence that the urban development of eastern Sindh did not occur abruptly but evolved gradually over several millennia. This evolutionary sequence provides an essential framework for understanding the emergence and development of settlements within the Nara Basin and demonstrates that the region formed part of a long-standing trajectory of cultural and urban evolution.

4.13 Amri

Amri is one of the most significant archaeological sites for understanding the formative stages of the Indus Civilization.

Principal Characteristics

- Pre-Harappan cultural occupation.
- Early stages of urban organization.
- Highly developed ceramic technology.
- An economy primarily based upon agriculture.

The archaeological sequence at Amri demonstrates that the process of urbanization within Sindh did not occur uniformly across the region. Instead, different areas experienced urban development at varying rates and through distinct developmental trajectories, reflecting regional environmental and cultural diversity.

4.14 Mohenjo-daro

A Major Urban Centre

Mohenjo-daro represents the largest and most sophisticated urban centre of the Indus Civilization. Its carefully planned streets, advanced drainage system, monumental public architecture, and standardized construction techniques

illustrate the remarkable level of urban planning achieved during the Mature Harappan Period.

Relationship with the Nara Basin

Although Mohenjo-daro is not situated within the Nara Basin itself, numerous agricultural and commercial settlements located in the basin were closely integrated with this major metropolitan centre.

These connections are reflected through:

- Agricultural production and food supply.
- Procurement and distribution of raw materials.
- Commercial exchange networks.
- Shared cultural traditions and technological practices.

Consequently, the Nara Basin should be regarded as part of the wider economic hinterland that sustained the major urban centres of the Indus Civilization.

4.15 Ganweriwala

Significance

Ganweriwala, located in the Cholistan Desert, is regarded as one of the largest urban centres of the Indus Civilization. **Rafique Mughal** identified the site as one of the principal Harappan cities and emphasized its importance for understanding settlement organization within the eastern sector of the civilization.

Relationship with the Nara Basin

The archaeological evidence suggests several important connections between Ganweriwala and the Nara Basin, including:

- Ancient commercial interactions.
- Comparable ceramic traditions.
- Association with similar palaeochannel systems.
- Comparable floodplain-based agricultural economies.

These similarities indicate that both regions probably formed components of the same regional cultural and economic network during the Harappan period.

4.16 Jalilpur

Archaeological discoveries at Jalilpur demonstrate that important cultural interactions existed between eastern Punjab and eastern Sindh during the Harappan period.

These connections suggest that the Nara Basin was linked with northern regions through broader networks of communication, exchange, and cultural interaction, thereby reinforcing its position within the extensive territorial framework of the Indus Civilization.

4.17 Minor Archaeological Sites of the Nara Basin

Numerous smaller archaeological sites are distributed throughout eastern Sindh, many of which remain insufficiently investigated and have yet to undergo systematic excavation.

Surface surveys at these sites have recovered:

- Harappan ceramics.
- Flint tools.
- Brick fragments.
- Animal bones.
- Botanical remains, including evidence of cereal cultivation.

These smaller settlements demonstrate that the Nara Basin was not composed solely of large urban centres. Rather, it contained hundreds of agricultural villages that collectively supported the broader settlement system of the Indus Civilization. Their distribution illustrates the importance of rural communities in sustaining agricultural production, local exchange, and regional economic integration.

4.18 Trade Networks

The archaeological case studies presented above indicate that the Nara Basin formed an integral component of the commercial system of the Indus Civilization.

Current evidence suggests:

- The basin participated actively in regional exchange networks.
- Commercial connections existed with Cholistan, Sindh, and Gujarat.
- Semi-precious stones were probably exchanged through long-distance trade.
- Agricultural surplus was transported to major urban centres.

These observations indicate that the Nara Basin contributed significantly to the economic integration of the Indus Civilization and participated in exchange systems extending across diverse ecological regions.

4.19 Environmental Adaptation

The geographical distribution of archaeological sites demonstrates that ancient communities carefully adapted their settlements to local environmental conditions.

Settlement selection was characterized by:

- Establishment near dependable water sources.
- Preference for elevated locations safe from seasonal flooding.
- Convenient access to fertile agricultural land.
- Continuous adaptation to changing climatic and hydrological conditions.

Such environmental adaptation constituted one of the principal factors underlying the long-term success and resilience of the Indus Civilization.

4.20 Critical Review

Several important conclusions emerge from these archaeological case studies.

First, the archaeological sites of the Nara Basin were closely integrated into the broader urban network of the Indus Civilization.

Second, none of the settlements functioned in complete isolation. Each site formed part of a larger regional economic, social, and cultural system connected through agricultural production, trade, and communication.

Third, recent geoarchaeological investigations demonstrate that ancient river channels constituted one of the principal determinants influencing settlement location and long-term occupation.

Fourth, many archaeological sites in eastern Sindh remain insufficiently explored. The absence of systematic excavation, comprehensive geoarchaeological investigation, high-resolution spatial mapping, and modern chronological analyses limits current understanding of the region's archaeological significance.

Accordingly, future multidisciplinary field research is essential for refining interpretations of settlement dynamics, environmental history, and cultural development within the Nara Basin.

4.21 Interim Conclusions

The archaeological evidence reviewed in this section clearly demonstrates that the Nara Basin formed an active and significant component of the eastern cultural sphere of the Indus Civilization. Early urban centres such as Kot Diji, interactions with the major cities of Cholistan, the widespread distribution of agricultural villages, and settlement concentration along ancient palaeochannels collectively indicate the existence of an organized, multi-tiered, and environmentally adapted civilization.

At the same time, contemporary research also reveals that many archaeological sites within the Nara Basin remain inadequately investigated. Comprehensive archaeological surveys, modern excavations, geophysical prospection, high-resolution remote sensing, and advanced chronological analyses are still required.

Future interdisciplinary investigations integrating archaeology, geoarchaeology, geomorphology, palaeohydrology, environmental science, and remote sensing will undoubtedly provide a more comprehensive understanding of the historical development, environmental evolution, and eastern expansion of the Indus Civilization.

Note: In this section, certain archaeological sites—such as **Mohenjo-daro** and **Amri**—have been included for comparative purposes. Although these sites are not located within the Nara Basin itself, they provide essential comparative evidence for understanding the archaeological development, settlement organization, and cultural evolution of the Nara Basin within the broader context of the Indus Civilization.

Chapter Four

Part Four

The Archaeological Landscape of the Nara Basin: Ancient Sites and Settlement Systems of Eastern Sindh

4.22 Introduction

Within the archaeology of the Indus Civilization, eastern Sindh has historically received comparatively limited scholarly attention. However, recent advances in archaeology, geoarchaeology, remote sensing, and Geographic Information Systems (GIS) have demonstrated that hundreds of small and medium-sized archaeological sites are distributed along the ancient palaeochannels associated with the Nara Basin. The spatial distribution of these sites

indicates that the region formed an integral component of a well-organized agricultural, economic, and communication system within the eastern sector of the Indus Civilization.

Foundational research on the archaeology of eastern Sindh has been conducted by scholars including **Rafique Mughal**, **M. H. Panhwar**, **Jonathan Mark Kenoyer**, **Gregory L. Possehl**, and numerous other researchers whose studies have significantly enhanced our understanding of the historical geography, settlement patterns, and cultural development of the Nara–Hakra system. Their work has established that the archaeological record of the Nara Basin should be interpreted within a broader regional framework encompassing environmental change, fluvial evolution, and long-term human occupation.

4.23 Archaeological Zoning of the Nara Basin

Based upon the present distribution of archaeological sites, the Nara Basin may provisionally be divided into three principal archaeological zones. Although these divisions remain analytical rather than absolute, they provide a useful framework for understanding regional settlement organization.

(a) Northern Zone

The northern zone includes the modern districts of **Khairpur**, **Naushahro Feroze**, and the adjoining eastern regions.

Its principal characteristics include:

- A high concentration of ancient palaeochannels.
- Evidence of early agricultural settlements.
- Numerous Pre-Harappan and Early Harappan archaeological sites.
- Natural hydrological connections with the Indus River.

This region appears to have played a significant role during the early territorial expansion of the Indus Civilization and represents one of the earliest centres of organized settlement within eastern Sindh.

(b) Central Zone

The central zone encompasses the eastern parts of **Sanghar**, **Shahdadpur**, and the corridor associated with the Nara Basin.

Archaeological evidence indicates that this region contains:

- Numerous settlements belonging to the Mature Harappan Period.
- Clear evidence of intensive agricultural production.
- Possible remains of ancient irrigation systems.
- A network of interconnected palaeochannels.

These characteristics suggest that the central zone constituted one of the principal agricultural heartlands of the Nara Basin, supporting both rural communities and regional economic activities.

(c) Southern Zone

The southern zone includes the regions of **Umerkot**, **Diplo**, **Nagarparkar**, and the areas extending toward the **Rann of Kachchh**.

This region was strategically important because:

- Trade routes connected it with Gujarat and Kachchh.

- It formed a transitional zone between desert and agricultural landscapes.
- Pastoralism and commercial activities were closely integrated.
- Seasonal settlements developed in response to fluctuating water availability.

Its geographical position made the southern zone an important interface between the Indus Civilization and the wider regions of western India.

4.24 Settlement Patterns within the Nara Basin

Recent GIS-based investigations demonstrate that settlement distribution within the Nara Basin was highly systematic rather than random.

Archaeological sites are generally characterized by the following locational features:

- Proximity to ancient river channels.
- Establishment on elevated natural landforms.
- Close association with fertile agricultural land.
- Direct access to regional trade and communication routes.

Such carefully selected settlement locations reflect the sophisticated environmental knowledge possessed by Harappan communities and illustrate the planned nature of settlement organization throughout the region.

The observed settlement pattern further supports the interpretation that environmental conditions, particularly water availability, exerted a decisive influence upon the development and long-term sustainability of human occupation within the Nara Basin.

4.25 Water and Cultural Development

Water constituted the fundamental factor underlying the cultural and economic development of the Nara Basin.

Its influence may be observed across several interconnected sectors.

Agricultural Production

Reliable water resources supported the cultivation of:

- Wheat.
- Barley.

- Sesame.
- Cotton.
- Fodder crops for domesticated livestock.

The availability of fertile alluvial soils and seasonal flooding created highly favourable conditions for agricultural intensification.

Settlement Development

Water availability facilitated the establishment of:

- Permanent villages situated near dependable water sources.
- Seasonal settlements adapted to changing hydrological conditions.
- Agricultural communities supporting regional food production.

Craft Production

The stability provided by agricultural surplus encouraged the development of specialized industries, including:

- Pottery manufacture.
- Brick production.
- Metallurgical activities.
- Bead manufacturing.

Trade and Transportation

Water systems also played a central role in commercial activities by supporting:

- Riverine transportation.
- Overland caravan routes.
- Regional exchange networks.

Collectively, these factors demonstrate that water functioned as the principal organizing element of the social, economic, and cultural landscape of the Nara Basin.

4.26 The Shared Cultural System of the Nara Basin and Cholistan

Archaeological investigations reveal numerous similarities between eastern Sindh and the Cholistan region.

These include:

- Comparable ceramic traditions.
- Similar settlement organization.
- Closely related agricultural practices.
- Extensive commercial interaction.
- Comparable distributions of palaeochannels.

These shared characteristics strongly suggest that the two regions were not isolated cultural entities but rather formed parts of a single, integrated cultural zone within the eastern domain of the Indus Civilization.

The archaeological evidence therefore supports the interpretation that environmental adaptation, agricultural production, and regional exchange created a broad interconnected civilization extending across eastern Sindh and Cholistan.

4.27 Archaeology and Environmental Change

Modern geoarchaeological research demonstrates that environmental fluctuations exerted a direct influence upon settlement dynamics throughout the Nara Basin.

Periods of increased water availability were generally associated with:

- Expansion of cultivable land.
- Population growth.
- Intensification of regional trade.

Conversely, periods of declining water availability resulted in:

- Relocation of settlements.
- Reorganization of trade routes.
- Reduction in agricultural productivity.

Importantly, recent interdisciplinary research does not support earlier theories proposing a sudden or complete collapse of human occupation. Instead, archaeological evidence indicates that communities adapted gradually to environmental transformations through changes in settlement organization, subsistence strategies, and economic activities.

4.28 Social Organization of the Nara Basin

Archaeological evidence suggests that the Nara Basin possessed a complex and interconnected social structure composed of:

- Small agricultural villages.
- Intermediate settlements.
- Commercial centres.
- Agricultural production zones.

These settlement categories were economically and socially interconnected, forming part of a broader regional system linked to larger urban centres of the Indus Civilization.

Such evidence reflects a hierarchical settlement organization comparable to that documented in other regions of the Harappan world.

4.29 Results of Recent Research

Research conducted during the past two decades has produced several important conclusions concerning the archaeology of the Nara Basin.

These investigations demonstrate that:

- The Nara Basin constituted an active component of the Indus Civilization.
- A strong spatial relationship exists between ancient palaeochannels and archaeological settlements.
- Earlier interpretations of eastern Sindh were incomplete owing to limited archaeological investigation.
- Modern satellite imagery has facilitated the identification of numerous previously unknown archaeological sites.
- Geoarchaeological research has provided a more rigorous scientific basis for evaluating traditional historical interpretations.

These developments have substantially enhanced our understanding of settlement organization and environmental history within the eastern Indus Civilization.

4.30 Critical Assessment

Current archaeological and geoarchaeological evidence indicates that the Nara Basin should not be interpreted solely as the terminal reach of the Hakra River or merely as the course of the modern Nara Canal.

Rather, it should be understood as a:

- **Geoarchaeological Landscape**
- **Cultural Corridor**
- **Agricultural Frontier**
- **Trade Zone**
- **Dynamic Environmental System**

This interdisciplinary interpretation provides a more comprehensive and scientifically robust explanation of the region's long-term cultural development and environmental evolution than earlier single-factor models.

4.31 Interim Conclusion

The evidence presented in this section clearly demonstrates that the Nara Basin formed an important component of the eastern cultural landscape of the Indus Civilization. Ancient river channels, productive agricultural resources, regional trade networks, and interconnected settlement systems collectively created a dynamic cultural landscape that supported long-term human occupation and economic development.

The results obtained through archaeology, GIS, remote sensing, geoarchaeology, and environmental reconstruction consistently indicate that eastern Sindh should no longer be regarded merely as a peripheral frontier of the Indus Civilization. Instead, it should be recognized as an active and integral element of the civilization's broader cultural and economic system.

Nevertheless, significant research challenges remain. Many archaeological sites within the Nara Basin require systematic excavation, laboratory-based chronological analysis, palaeobotanical and zooarchaeological investigation, geophysical survey, and comprehensive environmental reconstruction. Future interdisciplinary research integrating these approaches will undoubtedly

provide a more detailed and scientifically grounded understanding of the cultural evolution, environmental history, and regional significance of the Nara Basin within the wider context of the Indus Civilization.

Chapter Four

Part Five

The Economic System of the Nara Basin: Agriculture, Irrigation, Craft Production, and Trade Networks

4.32 Introduction

The stability and prosperity of any ancient civilization depended fundamentally upon the strength of its economic foundations. The remarkable success of the Indus Civilization was not solely the result of sophisticated urban planning or advanced architectural techniques; rather, it rested upon a well-developed agricultural economy, effective water management, specialized craft production, organized trade networks, and an integrated social structure. The Nara Basin, forming an important component of the ancient fluvial

landscape of eastern Sindh, played a significant role in each of these economic activities.

Recent archaeological, archaeobotanical, zooarchaeological, and geoarchaeological investigations indicate that the inhabitants of the Nara Basin successfully adapted to their environmental conditions and established an economic system capable of sustaining long-term settlement despite periodic climatic and hydrological fluctuations. This resilience illustrates the sophisticated environmental knowledge and economic organization that characterized the eastern sector of the Indus Civilization.

4.33 Agricultural Economy

Agriculture constituted the principal foundation of the economy of the Indus Civilization, and the agricultural prosperity of the Nara Basin was closely dependent upon the availability of water. Seasonal flooding deposited fertile alluvial sediments across the floodplains, thereby enhancing soil productivity and facilitating systematic cultivation.

Archaeobotanical evidence indicates that the principal crops cultivated in the region included:

- Wheat (*Triticum aestivum*).
- Barley (*Hordeum vulgare*).
- Cotton (*Gossypium arboreum*), regarded as one of the earliest domesticated cotton species in the world.
- Sesame (*Sesamum indicum*).
- Probably various legumes and fodder crops.

Agricultural production not only fulfilled local subsistence requirements but also generated surplus commodities that could be exchanged with neighbouring regions. This agricultural surplus represents an important indicator of economic specialization, organized production, and regional integration within the broader Harappan economy.

4.34 Water Management and Irrigation

The nature of irrigation practices within the Indus Civilization remains the subject of scholarly debate. Nevertheless, most researchers agree that Harappan communities relied primarily upon seasonal flooding, natural river channels, and locally available water resources rather than extensive artificial canal systems.

Within the Nara Basin, water management may have included:

- Floodwater farming.
- Diversion of water from natural river channels.
- Small embankments or temporary water-control structures.
- Storage reservoirs and wells.

At present, no conclusive archaeological evidence demonstrates the existence of a large-scale, human-engineered canal irrigation system within the Nara Basin during the Mature Harappan Period. Consequently, interpretations concerning irrigation practices should remain cautious and firmly grounded in available archaeological evidence.

The available data instead suggest a flexible system of environmental adaptation in which communities efficiently exploited naturally occurring hydrological processes.

4.35 Animal Husbandry

Animal husbandry constituted an essential component of the agricultural economy.

Zooarchaeological investigations demonstrate that the principal domesticated animals included:

- Cattle and oxen.
- Water buffalo.
- Sheep.
- Goats.
- Camels, particularly during the later phases of occupation.

These animals performed multiple economic functions, including agricultural labour, transportation, dairy production, meat supply, and commercial exchange.

The integration of crop cultivation and livestock management contributed significantly to the sustainability and resilience of the regional economy.

4.36 Craft Production

Archaeological discoveries from the Nara Basin demonstrate the existence of several well-developed craft industries that formed an important component of the regional economy.

Pottery Production

Potters produced standardized red ware decorated with black-painted geometric motifs, large storage jars, cooking vessels, and a wide range of domestic ceramics.

The consistency of manufacturing techniques indicates a high degree of technological specialization and adherence to standardized production methods throughout the Harappan cultural sphere.

Bead Manufacturing

Beads were manufactured from:

- Agate.
- Carnelian.
- Faience.
- Other semi-precious stones.

These ornaments were widely used for personal adornment and also constituted valuable commodities within regional and long-distance exchange networks.

Metallurgy

Limited evidence has been recovered for the production and use of copper and bronze implements, including:

- Tools.
- Needles.
- Knives.
- Hooks.
- Various utilitarian objects.

These artifacts demonstrate the presence of skilled metalworkers and the acquisition of raw materials through regional trade.

Shell and Bone Industries

As elsewhere in the Indus Civilization, shell ornaments and bone tools formed important components of local craft production.

Marine shell was fashioned into personal ornaments, while animal bone was employed in the manufacture of tools and other utilitarian objects, reflecting both technological ingenuity and access to diverse raw materials.

4.37 Trade Networks

The geographical position of the Nara Basin connected it strategically with regions to the north, south, east, and west.

Its principal commercial connections extended toward:

- The major urban centres of the Indus Valley to the north.
- Cholistan and Rajasthan to the east.
- Kachchh and Gujarat to the south.
- Settlements along the main course of the Indus River to the west.

Trade likely involved the exchange of:

- Agricultural surplus.
- Pottery.
- Beads.
- Metal implements.
- Semi-precious stones.
- Cotton and textile products.

These extensive exchange networks illustrate the high degree of regional economic integration that characterized the Indus Civilization and confirm the important commercial role played by the Nara Basin within this broader system.

4.38 Social Organization

Archaeological evidence indicates that society within the Nara Basin possessed a structured and multi-layered organization.

The principal social groups probably included:

- Farmers and pastoralists.
- Craft specialists.
- Merchants and traders.
- Administrative officials or local leaders.
- Individuals responsible for religious or ceremonial activities.

The hierarchical distribution of settlements, together with evidence of specialized production and regional exchange, suggests the existence of organized administrative and economic relationships linking communities throughout the basin.

Such organizational complexity reflects the sophisticated social institutions characteristic of the Mature Harappan Civilization.

4.39 Economic Stability and Environmental Change

During the later phases of the Holocene, climatic variability, changes in river courses, and declining

water availability influenced economic activities throughout the Nara Basin.

Current interdisciplinary research, however, indicates that these transformations occurred gradually rather than abruptly.

As environmental conditions evolved:

- Certain agricultural zones shifted geographically.
- Trade routes were reorganized.
- Some settlements declined in size or importance.
- Communities adapted successfully to changing environmental conditions.

These developments demonstrate the remarkable resilience of the Harappan economic system and illustrate the capacity of local populations to modify their subsistence strategies in response to long-term environmental change.

4.40 Critical Analysis

Several important conclusions emerge from the economic history of the Nara Basin.

First, effective water management constituted the primary foundation of agricultural production and permanent settlement.

Second, agriculture, animal husbandry, craft production, and commerce functioned as interdependent components of a highly integrated economic system.

Third, the Nara Basin should not be interpreted as a peripheral frontier but rather as an active participant within the regional economic network of the Indus Civilization.

Fourth, advances in archaeobotany, zooarchaeology, geoarchaeology, remote sensing, and GIS-based spatial analysis have provided more rigorous scientific frameworks for evaluating earlier historical interpretations.

Nevertheless, important research gaps remain. Additional archaeological excavation, archaeobotanical sampling, laboratory analysis, and geoarchaeological investigation are required to clarify patterns of crop cultivation, irrigation practices, local production systems, and the organization of commercial centres within the Nara Basin.

4.41 Conclusion

The economic system of the Nara Basin was founded upon a complex and integrated structure in which agriculture, animal husbandry, craft production, trade, and water management functioned as mutually reinforcing components. This diversified economic organization not only ensured the long-term sustainability of local communities but also contributed significantly to the prosperity and stability of the wider urban and commercial system of the Indus Civilization.

Current scientific evidence indicates that the Nara Basin should be regarded as a major component of the **economic geography of the Indus Civilization**. Continued interdisciplinary research integrating archaeology, archaeobotany, zooarchaeology, geoarchaeology, environmental science, and remote sensing promises to provide a more comprehensive understanding of the region's economic organization and its contribution to one of the world's earliest urban civilizations.

Chapter Four

Part: 06

General Discussion, Scholarly Synthesis, and Chapter Conclusion

4.42 General Discussion

This chapter has presented a critical examination of the archaeology of the Nara Basin by integrating evidence relating to settlement patterns, ancient fluvial systems, agricultural production, trade networks, and social organization. The synthesis of these diverse lines of evidence clearly demonstrates that the Nara Basin constituted an important and dynamic component of the eastern cultural sphere of the Indus Civilization, whose significance has historically been underestimated.

During the early decades of the twentieth century, archaeological research on the Indus Civilization

focused primarily on the major urban centres, particularly Mohenjo-daro and Harappa. Consequently, eastern Sindh, Cholistan, and the Hakra–Nara region were generally regarded as peripheral areas of secondary importance. However, archaeological investigations conducted over the past five decades—especially the pioneering Cholistan surveys of **Rafique Mughal**, subsequent archaeological research in eastern Sindh, and recent geoarchaeological studies—have fundamentally transformed this perspective.

It is now widely recognized that the Indus Civilization was not merely an aggregation of a few large cities but rather a vast, **multi-centric**, **multi-layered**, and environmentally integrated civilization. Within this complex settlement system, small agricultural villages, intermediate settlements, trading stations, and major urban centres were interconnected through economic, social, and cultural relationships. The archaeological evidence from the Nara Basin strongly supports this interpretation and demonstrates that eastern Sindh formed an integral part of this wider civilization.

4.43 The Civilizational Significance of the Nara Basin

The findings of the present study indicate that the Nara Basin should be interpreted from three complementary perspectives.

(a) An Agricultural Frontier

During antiquity, the Nara Basin constituted an exceptionally productive agricultural region. Fertile alluvial deposits, seasonal floodwaters, and rich floodplain soils created favourable conditions for sustained cultivation, making the basin an important component of the agricultural economy of the Indus Civilization.

(b) A Trade Corridor

Its strategic geographical position between eastern Sindh, Cholistan, Kachchh, Gujarat, and the Indus Valley enabled the Nara Basin to function as an important regional trade corridor. Both overland communication routes and possible riverine transport facilitated the movement of agricultural products, manufactured goods, and raw materials between different ecological and cultural regions.

(c) A Cultural Interface

Situated at the intersection of several environmental zones, the Nara Basin also served

as an important arena for cultural interaction. The region facilitated technological diffusion, cultural exchange, and social interaction between neighbouring communities, thereby contributing to the cultural diversity and cohesion of the eastern Indus Civilization.

4.44 A New Interpretation in the Light of Geoarchaeology

Recent developments in geoarchaeology have fundamentally transformed the interpretation of the Nara Basin.

Earlier archaeological investigations focused primarily upon the recovery and classification of artifacts. Contemporary research, by contrast, adopts an interdisciplinary perspective that integrates multiple categories of evidence, including:

- Ancient palaeochannels.
- Sedimentological investigations.
- Geomorphological analysis.
- Satellite imagery.
- Geographic Information Systems (GIS).
- Palaeoenvironmental reconstruction.
- Archaeological settlement data.

The integration of these diverse datasets demonstrates that the Nara Basin should be understood as a **Geoarchaeological Landscape**, in which natural processes and human activities interacted continuously over several millennia. Such an approach provides a far more comprehensive understanding of regional settlement dynamics than artifact-based interpretations alone.

4.45 Environment and Cultural Development

The present investigation further demonstrates that environmental change influenced the development of the Indus Civilization; however, environmental factors alone cannot adequately explain its historical trajectory.

Current interdisciplinary research indicates that:

- Climatic fluctuations occurred gradually rather than abruptly.
- River systems changed their courses through multiple phases over extended periods.
- Environmental transformations varied considerably from one region to another.

- Human communities continuously adapted to changing ecological conditions.

Consequently, the traditional model of a **"Sudden Collapse"** has become increasingly difficult to sustain. Instead, the concept of **"Gradual Transformation and Adaptation"** provides a more scientifically robust explanation of the archaeological and environmental evidence. This perspective recognizes the resilience of Harappan societies and their capacity to respond to long-term environmental variability through economic, technological, and social adaptation.

4.46 Contemporary Scholarly Perspectives on the Nara and Hakra Systems

This study has undertaken a comparative evaluation of the principal scholarly interpretations concerning the Nara, Hakra, and related palaeofluvial systems.

Based upon the currently available evidence, several conclusions may be drawn:

- The modern Nara Canal follows, to a considerable extent, the course of an ancient natural river channel.

- This palaeochannel appears to have remained active to varying degrees during different chronological periods.
- Historical and geographical relationships existed among the Hakra, Puran, and Nara systems; however, these relationships were neither uniform nor constant through time.
- No single, simplified hypothesis is fully supported by the available archaeological, geological, and geomorphological evidence. Accordingly, future interpretations should be based upon the integrated evaluation of multiple independent datasets.

This multidisciplinary approach provides a more balanced framework for reconstructing the complex hydrological history of eastern Sindh.

4.47 Contribution of the Present Study

The present research makes several significant contributions to the existing scholarship.

First, it establishes the Nara Basin as an independent and coherent subject of archaeological and historical investigation rather than treating it merely as a subsidiary component of the Hakra debate.

Second, it integrates history, archaeology, geology, hydrology, geoarchaeology, remote sensing, and GIS within a unified interdisciplinary analytical framework.

Third, it reinterprets the archaeological landscape of eastern Sindh by demonstrating its close integration with the broader settlement system of the Indus Civilization.

Fourth, it combines recent international scholarship with regional historical sources, thereby providing a more comprehensive and balanced interpretation of the archaeological evidence.

Collectively, these contributions enhance current understanding of the eastern expansion, environmental adaptation, and regional diversity of the Indus Civilization.

4.48 Recommendations for Future Research

Although substantial progress has been achieved, numerous research questions remain unresolved. Future investigations should focus upon the following priorities:

- Comprehensive GIS mapping of the entire Nara Basin.
- Identification of previously unknown archaeological sites through LiDAR and Ground Penetrating Radar (GPR).
- Expanded Radiocarbon and Optically Stimulated Luminescence (OSL) dating programmes.
- Detailed palaeoenvironmental reconstruction.
- Comprehensive archaeobotanical and zooarchaeological analyses.
- Ancient DNA and stable isotope investigations.
- Systematic excavation of uninvestigated archaeological sites in eastern Sindh.
- Comparative international research on the Nara Basin within the broader context of ancient riverine civilizations.

The implementation of these research strategies will significantly strengthen future interpretations of the archaeological and environmental history of the region.

4.49 Chapter Conclusion

The archaeological, geographical, geoarchaeological, and palaeoenvironmental evidence presented throughout this chapter demonstrates that the Nara Basin occupied a position of considerable importance in the development of the Indus Civilization. Settlement distribution was closely associated with ancient river channels, productive agricultural landscapes, and regional trade networks, confirming that the basin functioned not merely as a peripheral frontier but as an active cultural and economic centre within the eastern domain of the civilization.

The integrated examination of archaeological sites, ceramic traditions, agricultural production, commercial interaction, and social organization further indicates that the Nara Basin formed part of a coherent **Integrated Cultural Landscape**, whose long-term development resulted from the continuous interaction of environmental processes and human innovation.

At the same time, recent geoarchaeological investigations and remote-sensing analyses demonstrate that the ancient fluvial systems of eastern Sindh were highly dynamic rather than static. River courses, discharge regimes, and hydrological activity changed repeatedly over thousands of years. Consequently, any

interpretation of the Nara, Hakra, or Puran systems must be based upon the careful integration of archaeological, geological, geomorphological, hydrological, and palaeoenvironmental evidence rather than upon a single explanatory model.

In conclusion, the archaeological landscape of eastern Sindh and the Nara Basin occupies a central position in the study of the Indus Civilization. Continued interdisciplinary research, incorporating advanced scientific methodologies and systematic archaeological field investigations, promises to refine our understanding of the region's historical development, environmental evolution, and cultural significance.

This chapter also provides the conceptual and historical foundation for the succeeding chapter, which examines the historical evolution of the Nara Basin from the Early Historic and Islamic periods through the Kalhora, Talpur, and British administrations. Particular attention will be devoted to the transformation of the region's hydraulic system, the development of the modern Nara Canal, and its long-term social, economic, and agricultural consequences.

Chapter Five

The Nara in the Historical Period: From the Islamic Era to the Modern Irrigation System

5.1 Introduction

The historical significance of the Nara Basin extends far beyond the period of the Indus Civilization. Throughout successive historical eras, the region remained politically, economically, and agriculturally important. The ancient fluvial channel, known at various times by names such as **Nara**, **Puran**, **Eastern Nara**, and other local designations, continued to play an important role during the Islamic, Samma, Arghun, Tarkhan, Kalhora, Talpur, and British periods in different forms and to varying degrees.

The principal objective of this chapter is to critically examine these successive historical

phases and to explain the transformation of the Nara from a naturally flowing river channel into the modern irrigation canal system. By integrating historical documentation with recent geoarchaeological and hydrological research, this chapter explores the continuity and changing functions of the Nara Basin over more than a millennium.

5.2 The Nara in Historical Sources

Numerous historical and geographical sources from antiquity and the medieval period refer to the fluvial system of eastern Sindh, although the name **"Nara"** was not always used consistently. Arab geographers, Persian historians, and later British surveyors recorded rivers, distributary channels, seasonal streams, and wetlands that formed the hydrological landscape of eastern Sindh.

Historical descriptions indicate that the region's river system was highly dynamic rather than static. Continuous changes in river courses, seasonal flooding, sediment deposition, and channel migration altered the hydrological landscape over time. Consequently, the same river course was frequently known by different

names during different historical periods, reflecting both environmental change and evolving local traditions.

These historical accounts collectively suggest that the waterways of eastern Sindh remained significant geographical features throughout the medieval and early modern periods, even though their configuration changed repeatedly.

5.3 The Importance of the Nara During the Islamic Period

Following the establishment of Muslim rule in Sindh during the eighth century CE, considerable attention was devoted to agricultural production, irrigation management, and land revenue administration. Areas of eastern Sindh containing natural river channels or seasonal watercourses became important centres of agricultural activity.

Accounts recorded by Arab historians and geographers indicate that:

- Agricultural lands were closely dependent upon reliable water availability.
- Settlements were established along natural river channels and seasonal streams.

- Local administrative institutions regulated the distribution and management of irrigation water.
- Several districts of eastern Sindh derived considerable economic importance from agricultural production.

Although detailed hydrological maps from the period have not survived, the historical evidence consistently suggests that the Nara region remained inhabited and agriculturally productive. Water availability continued to determine settlement distribution, agricultural prosperity, and regional economic development.

5.4 The Samma and Arghun–Tarkhan Periods

During the rule of the **Samma Dynasty (1351–1524 CE)**, agricultural production in Sindh achieved increased stability and expansion. Irrigation continued to depend largely upon natural river channels, floodwaters, depressions, and distributary systems that supplied water to cultivated lands.

Under the subsequent **Arghun** and **Tarkhan** dynasties, the agricultural importance of eastern Sindh remained largely intact, although periods of political instability and military conflict adversely

affected certain settlements and irrigation facilities.

Historical documents from these periods suggest that:

- Maintenance of natural watercourses continued largely through local administrative arrangements.
- Agricultural productivity remained a central concern of regional governance.
- Water management practices continued to rely primarily upon existing natural fluvial systems rather than large-scale engineered canals.

Despite changing political regimes, the close relationship between settlement, agriculture, and water resources remained a defining characteristic of the Nara Basin.

5.5 The Hydraulic System of Eastern Sindh During the Mughal Period

Within the administrative structure of the **Mughal Empire**, Sindh occupied an important position because of its agricultural productivity and revenue potential. Consequently, considerable attention was devoted to land surveys, revenue

assessment, and the maintenance of irrigation systems.

In eastern Sindh:

- Irrigation continued to depend primarily upon natural distributary channels.
- Seasonal floodwaters were extensively utilized for agricultural cultivation.
- Local landholders and farming communities played significant roles in regulating water distribution.

Several Persian administrative and historical sources describe the cultivated districts and agricultural productivity of eastern Sindh. Although these documents provide only limited technical information regarding the Nara itself, they nevertheless confirm the continuing economic significance of the region and its dependence upon reliable water resources.

The Mughal period therefore represents an important stage in the long-term continuity of agricultural settlement within the Nara Basin.

5.6 Critical Evaluation of the Historical Evidence

A comparative examination of historical sources from the Islamic, Samma, Arghun, Tarkhan, and

Mughal periods leads to several important conclusions.

First, the hydraulic system of eastern Sindh underwent continuous transformation rather than remaining geographically fixed.

Second, ancient river channels did not disappear completely but instead continued to function intermittently or seasonally during different historical periods.

Third, agricultural settlement consistently remained dependent upon the availability and management of water resources.

Fourth, although historical narratives cannot independently verify every aspect of the ancient hydrological system, their general descriptions correspond closely with the findings of recent geoarchaeological investigations, remote-sensing studies, and palaeohydrological research.

Accordingly, the integration of documentary evidence with scientific investigation provides a more reliable framework for reconstructing the historical evolution of the Nara Basin than reliance upon either source of evidence alone.

5.7 Interim Conclusion

Historical sources demonstrate that the Nara Basin remained an area of considerable agricultural, economic, and administrative importance from the Islamic conquest through the Mughal period. Although the natural fluvial system underwent gradual environmental and hydrological transformations, settlement and agricultural production continued to develop along the surviving river channels and associated watercourses.

This historical continuity predates the construction of the modern Nara Canal by several centuries and confirms that the hydrological landscape of eastern Sindh sustained human settlement and agricultural production throughout the medieval and early modern periods.

The following section examines the **Kalhora** and **Talpur** periods in greater detail, with particular emphasis on the restoration and management of the Nara watercourse, irrigation policies, hydraulic engineering, and the role of regional rulers in shaping the historical development of the basin.

Chapter Five

Part Two

The Hydraulic System of the Nara During the Kalhora and Talpur Periods: Restoration, Agricultural Development, and Administrative Policies

5.8 Introduction

The **Kalhora (1701–1783 CE)** and **Talpur (1783–1843 CE)** periods occupy a distinguished place in the history of Sindh with respect to the development of irrigation, agricultural expansion, and the restoration of indigenous water-management systems. During both dynasties, agriculture formed the foundation of the regional

economy, making the maintenance of rivers, natural channels, flood distributaries, and irrigation canals a central objective of state policy. In eastern Sindh, efforts were undertaken to maintain and improve the flow of water through the Nara, Puran, and other ancient watercourses in order to increase agricultural productivity and encourage the cultivation of previously uncultivated lands.

This phase represents an important transitional period between the predominantly natural fluvial systems of earlier centuries and the increasingly engineered irrigation networks that were later formalized under British colonial administration.

5.9 Irrigation Policy During the Kalhora Period

The Kalhora rulers regarded agriculture as the principal foundation of state revenue and economic prosperity. Consequently, they invested considerable resources in the excavation of new canals, the rehabilitation of older waterways, and the maintenance of natural river channels throughout Sindh.

In eastern Sindh, the principal objectives of these irrigation initiatives included:

- Expanding the area under cultivation.
- Increasing agricultural production.
- Encouraging the establishment of new villages.
- Enhancing state revenue through increased land taxation.

The historian **Ghulam Rasul Mehr**, in his work *History of Sindh (Kalhora Period)*, records numerous examples of Kalhora irrigation projects, demonstrating that the cleaning, restoration, and extension of natural channels and irrigation canals formed an essential component of the dynasty's developmental policy.

Rather than constructing entirely new hydraulic systems, the Kalhora administration frequently utilized existing natural watercourses, adapting them to meet changing agricultural demands while minimizing engineering costs.

5.10 The Historical Relationship Between the Nara and the Puran

Persian and Sindhi historical sources from the Kalhora period contain numerous references to the **Puran** and the **Eastern Nara**, although historians do not agree completely regarding their

precise geographical extent or hydrological relationship.

Recent geographical and historical research suggests several important conclusions:

- The Puran was an ancient natural watercourse that carried water during different historical periods.
- The Eastern Nara appears, in several locations, to have followed or been connected with sections of this older fluvial channel.
- Progressive shifts in river courses altered both the volume of water and the geographical configuration of these waterways over time.

Modern scholarship therefore rejects the assumption that the Puran, Hakra, and Nara represented a single permanently flowing river existing simultaneously in an unchanged form. Instead, they are understood as components of a complex and evolving fluvial landscape shaped by successive phases of geomorphological change and human intervention.

5.11 Expansion of Agricultural Settlement

Improved water availability during the Kalhora period stimulated significant agricultural expansion throughout eastern Sindh.

Among the principal consequences were:

- The establishment of new villages.
- Increased cultivation of cotton, wheat, and barley.
- Expansion of pastoral activities.
- The emergence of local market centres.
- Growth in regional commercial activity.

As agricultural production expanded, settlement patterns also evolved in accordance with the distribution of reliable water resources. Communities increasingly concentrated along river channels, distributaries, and irrigation systems capable of sustaining permanent cultivation.

This relationship between hydraulic infrastructure and settlement development illustrates the close interaction between environmental management and economic growth during the Kalhora period.

5.12 The Importance of the Nara During the Talpur Period

Following the accession of the **Talpur Dynasty** in 1783 CE, considerable continuity was maintained in irrigation policy and agricultural administration.

During the Talpur period:

- Existing canals continued to be repaired and maintained.
- Seasonal floodwaters were utilized for agricultural irrigation.
- Local landholders assumed important responsibilities in regulating water distribution.
- Irrigation infrastructure was maintained to maximize agricultural productivity.

Early British administrative reports prepared after the annexation of Sindh further indicate that numerous ancient canals and natural watercourses in eastern Sindh remained in active use at the time of British occupation.

The Talpur administration therefore preserved and expanded many of the hydraulic practices inherited from the Kalhora period while adapting them to contemporary political and economic circumstances.

5.13 Administrative Organization

The management of irrigation was not merely a technical undertaking but formed part of a highly organized administrative system.

Responsibility for water management was shared among several groups, including:

- Local government officials.
- Landowners.
- Cultivators.
- Canal supervisors and maintenance personnel.

These individuals collectively supervised water allocation, canal maintenance, desilting operations, and the repair of embankments and distributary channels.

Such administrative cooperation contributed significantly to agricultural stability and ensured the effective utilization of available water resources throughout eastern Sindh.

5.14 Natural and Human Factors

The hydraulic system that developed during the Kalhora and Talpur periods cannot be explained

solely as the product of engineering works. Instead, it emerged through the interaction of natural environmental processes and deliberate human intervention.

Natural Factors

The principal natural influences included:

- Flooding of the Indus River.
- Natural distributary channels.
- Ancient palaeochannels.
- Continuous processes of sediment deposition.

Human Factors

Human intervention consisted primarily of:

- Excavation of irrigation canals.
- Cleaning and restoration of older river channels.
- Regulation and distribution of irrigation water.
- Construction and maintenance of embankments and canal banks.

The combination of these natural and anthropogenic processes sustained agricultural production across eastern Sindh for several

centuries and formed the basis of the region's economic prosperity.

5.15 Critical Assessment in the Light of Modern Research

Recent historical, geoarchaeological, and geomorphological investigations have significantly refined our understanding of irrigation development during the Kalhora and Talpur periods.

Most contemporary scholars agree that many irrigation canals utilized during these dynasties were not entirely new constructions. Instead, they frequently represented the rehabilitation, modification, or extension of pre-existing natural river channels and abandoned palaeochannels.

At the same time, however, current scientific evidence does not support the conclusion that the entire length of the modern Nara Canal follows the exact course of a single ancient river.

Rather, the present hydraulic system reflects a complex historical evolution involving:

- Ancient natural river channels.
- Artificially excavated canals.

- Progressive engineering modifications introduced during successive historical periods.

This cautious interpretation is more consistent with the combined evidence derived from historical documents, satellite imagery, geomorphological investigations, and modern geoarchaeological research than earlier simplified hypotheses.

5.16 Interim Conclusion

The Kalhora and Talpur periods represent a crucial stage in the hydraulic history of eastern Sindh. During these centuries, the restoration of ancient watercourses, expansion of cultivated land, organized water distribution, and the development of effective local administrative institutions ensured that the Nara region remained one of the most productive agricultural zones of Sindh.

At the same time, recent interdisciplinary research demonstrates that the irrigation policies of these dynasties can only be fully understood by considering both the natural evolution of the fluvial system and the cumulative impact of

human engineering. The hydraulic landscape of the Nara Basin was therefore neither entirely natural nor wholly artificial, but rather the product of continuous interaction between environmental processes and human adaptation over several centuries.

This historical background provides the essential context for understanding the subsequent transformation of the Nara into a formally engineered irrigation canal during the British colonial period—a process that fundamentally reshaped the agricultural geography, economy, and settlement patterns of eastern Sindh and is examined in the following section.

Chapter Five

Part Three

Formation of the Nara Canal in the British Era: From Eastern Nara to Sukkur Barrage

5.17 Introduction After the British conquest of Sindh in 1843, irrigation became a central part of their new economic and administrative policy. The primary aim of the colonial government was to increase agricultural production, expand land revenue, and strengthen the colonial economy through a systematic irrigation system. For this purpose, they surveyed Sindh's natural river courses, old channels, and seasonal streams, among which the Eastern Nara became the main focus. British engineers realized that the ancient river course in eastern Sindh, which carried seasonal water at different points, could be transformed into a major irrigation canal if supplied with permanent water from the Indus River.

5.18 British Survey and Identification of Eastern Nara After the conquest, the British initiated engineering and geographical surveys. These surveys aimed not only to assess the existing water system but also to explore the economic potential of ancient river courses. Findings revealed that:

- A vast natural course existed in eastern Sindh.
- Some parts were dry, while others carried seasonal water.
- With proper engineering, it could be converted into a permanent irrigation system.
- Thousands of acres of barren land could be cultivated. Based on these results, preliminary work on the Eastern Nara project began.

5.19 Captain J. G. Fife's Engineering Report One of the most important early documents on the Eastern Nara was prepared by Captain J. G. Fife (Royal Engineers) in the 1850s. Key points of his report:

- Use the existing natural course as the foundation.
- Introduce regulated water from the Indus River.

- Remove obstructions in the flow.
- Control water distribution.
- Expand agricultural settlement. Fife emphasized that the new canal would not be entirely freshly dug, but rather an engineering improvement of the existing natural course. Modern geoarchaeological research supports this observation, showing that many parts of the Nara Canal are linked to ancient natural courses, though modified by human intervention.

5.20 Early Engineering Works From the 1850s onward, the British government took phased steps:

- Established a new connection with the Indus River.
- Excavated and cleared natural courses.
- Strengthened canal banks.
- Built initial structures for water regulation.
- Began systematic monitoring of the flow. These measures led to significant expansion of agricultural lands in eastern Sindh.

5.21 British Irrigation Policy The colonial irrigation policy aimed to:

- Increase land revenue.
- Expand cotton and grain production.

- Support population growth.
- Make barren lands cultivable.
- Strengthen the colonial economy. Thus, the Nara became not just an engineering project but a vital instrument of British economic policy.

5.22 Sukkur Barrage and the Nara Canal In the early 20th century, a comprehensive plan was prepared to reorganize Sindh's irrigation system, culminating in the construction of the Sukkur Barrage in 1932. After its completion:

- Permanent water supply to the Nara was ensured.
- Water flow was regulated.
- Canal capacity was expanded.
- Vast areas of eastern Sindh came under permanent irrigation.
- The agrarian economy underwent fundamental transformation. From this stage onward, the modern form of the Nara Canal emerged.

5.23 Agricultural and Social Impact The project had wide-ranging consequences:

Agricultural Impact

- Significant increase in cultivated land.

- Expansion of cotton cultivation.
- Rise in grain production.
- Growth of horticulture.

Social Impact

- New villages were established.
- Population increased.
- Land ownership structures changed.
- Local economy expanded.

Economic Impact

- Agricultural exports rose.
- Railways and markets developed.
- Colonial trade system was further strengthened.

5.24 Critical Review in Light of Modern Research

Modern historical and geoarchaeological studies show that describing the Nara Canal in extreme terms is misleading.

- One view claims it was entirely a new man-made canal.
- Another insists it was simply the ancient Hakra river course. Evidence suggests a middle ground:
- Many sections were based on ancient natural courses.

- Some parts were newly excavated.
- Old channels were straightened.
- New structures were built for water control. Therefore, the Nara Canal is best understood as a **Hybrid Hydraulic Landscape**, combining natural geography with modern engineering.

5.25 Official Records and Historical Significance
Colonial gazetteers, irrigation reports, engineering surveys, and revenue records are key sources for Nara's history. Important among them are:

- Captain J. G. Fife's engineering reports.
- E. H. Aitken's *Gazetteer of the Province of Sind*.
- Irrigation records of the Bombay Presidency.
- Annual reports of the Sind Irrigation Department.
- Official documents on the Sukkur Barrage project. These sources are fundamental for understanding the canal's modern formation, engineering evolution, and agricultural impact.

5.26 Conclusion of the Section The British era marked a decisive turning point in the history of the Nara. Ancient natural courses of the Eastern Nara were integrated with systematic

engineering, modern irrigation principles, and colonial administration to lay the foundation of the present canal. The Sukkur Barrage completed this process, bringing profound changes to the agricultural, economic, and social structure of eastern Sindh. At the same time, modern research clarifies that the Nara Canal is neither purely a colonial engineering creation nor simply the unchanged course of an ancient river. Instead, it represents a water system shaped by the combined evolution of ancient river courses, local irrigation traditions, and British engineering.

Chapter Five

Part Four

Evolution of the Nara Canal after the Creation of Pakistan: Modern Irrigation System, Water Management, and Environmental Challenges

5.27 Introduction After the creation of Pakistan in 1947, Sindh's irrigation system became a fundamental part of national agricultural policy. Among the seven major canals linked to the Sukkur Barrage, the Nara Canal emerged as one of the most important sources of irrigation in eastern Sindh, supplying water to the vast agricultural regions of Khairpur, Sanghar, Mirpurkhas, Umerkot, and Tharparkar. During this period, significant changes were introduced in the engineering, water distribution, agricultural

expansion, and administrative framework of the Nara Canal. It became not merely an irrigation canal but the central axis of eastern Sindh's agrarian economy, social stability, and regional development.

5.28 Importance of the Nara Canal after Sukkur Barrage The organized irrigation system established with the construction of the Sukkur Barrage in 1932 was further expanded and stabilized after Pakistan's independence. Through the Nara Canal:

- Millions of acres of farmland came under permanent irrigation.
- Dry and semi-arid areas were made cultivable.
- New settlement schemes were supported.
- Food production increased significantly. Over time, the canal's role in eastern Sindh's agrarian economy grew even more vital.

5.29 Irrigation Administration System In Pakistan, irrigation responsibilities were primarily assigned to the provincial irrigation department, which managed the maintenance, water distribution, repairs, and modern engineering improvements of the Nara Canal. Key components of this system included:

- Regulation of water through head regulators.
- Distribution via branches (distributaries) and minor canals.
- Adjustment of flows according to seasonal demand.
- Canal cleaning and removal of silt deposits.
- Maintenance of irrigation infrastructure. These measures made water supply more organized, though disputes over shortages and distribution occasionally arose.

5.30 Impact on Agricultural Development

Permanent irrigation through the Nara Canal brought fundamental changes to eastern Sindh's agricultural structure. Major crops included:

- Wheat
- Cotton
- Sugarcane
- Rice (in suitable areas)
- Sunflower
- Vegetables
- Fodder crops Additionally, horticulture—especially mangoes, dates, and other fruits—flourished in many areas. The rise in agricultural output also stimulated the growth of markets, transport, and agro-industries.

5.31 Social and Economic Transformations
Expansion of irrigation through the Nara Canal led to significant social and economic changes.

Population Growth New settlements emerged due to water availability, and many villages grew into small towns.

Employment Opportunities expanded in farming, horticulture, livestock, transport, and agricultural trade.

Regional Development Irrigation contributed to the development of roads, markets, educational institutions, and healthcare facilities.

5.32 Issues of Water Distribution Despite being the backbone of agricultural development, the Nara Canal faced persistent challenges in water distribution:

- Seasonal shortages.
- Unequal distribution between upstream and downstream areas.
- Flow obstruction due to silt accumulation.
- Illegal water extraction.
- Wastage caused by administrative weaknesses. These issues remain critical challenges for modern irrigation management.

5.33 Environmental Challenges Modern research highlights several environmental problems linked to the Nara Canal:

(a) **Waterlogging** – Continuous irrigation raised groundwater levels in many areas, damaging farmland. (b) **Salinity** – Poor drainage and excessive irrigation increased soil salinity, reducing productivity. (c) **Climate Change** – Shifts in rainfall patterns, temperature, and river flows created new challenges for future irrigation. (d) **Biodiversity** – Alterations in natural wetlands and aquatic habitats affected local flora and fauna.

5.34 Modern Scientific Research Recent studies have examined the Nara Canal and its basin using:

- Remote sensing
- Geographic Information Systems (GIS)
- Hydrological modeling
- Geoarchaeology
- Environmental monitoring These studies show that effective water management requires not only engineering solutions but also consideration of environmental, social, and economic factors.

5.35 Recommendations for Sustainable Management Given current conditions, the following steps are considered essential:

- Regular canal cleaning and modern repairs.
- Digital monitoring for fair water distribution.
- Promotion of water-efficient agricultural practices.
- Improved drainage to address salinity and waterlogging.
- Inclusion of ancient paleo-channels and natural water systems in regional planning.
- Strengthening participatory irrigation management with local farmers' involvement.

5.36 Critical Review In Pakistan's era, the Nara Canal has remained a cornerstone of agricultural development, but it has also generated new challenges. Population growth, rising water demand, climate change, soil salinity, and administrative issues have placed increasing pressure on the irrigation system. Modern research indicates that future strategies must go beyond simply expanding water supply. Efficiency of water use, environmental protection, and scientific management must be integrated into policy frameworks.

5.37 Conclusion of the Section Since Pakistan's creation, the Nara Canal has become the central axis of eastern Sindh's agricultural, economic, and social development. Millions of acres have been

cultivated, agricultural output has risen, and regional economies have been transformed. However, water shortages, salinity, waterlogging, climate change, and administrative weaknesses pose major challenges for the future. Addressing these requires a combined strategy of modern scientific research, effective irrigation policies, and sustainable management of natural resources. This section brings the historical evolution of the Nara Canal into the modern era and lays the foundation for the next chapter, which will present a comprehensive analysis of the historical, geographical, and archaeological significance of the Nara Basin.

Chapter Six

Archaeology of the Nara Basin: Ancient Sites, Cultural Continuity, and Modern Archaeological Research

6.1 Introduction The Nara Basin, located in eastern Sindh, is a geographical and archaeological region of fundamental importance to the study of the Indus Valley Civilization. Hundreds of ancient sites have been identified here, providing evidence of continuous human settlement from the Early Harappan, Mature Harappan, and Late Harappan phases through to historical periods. In the early 20th century, archaeological research focused mainly on major urban centers such as Mohenjo-daro and Harappa, while the Nara Basin remained relatively underexplored. However, since the 1960s,

scholars including Dr. Rafique Mughal, M. R. Mughal, George Dales, Jonathan Mark Kenoyer, Rita Wright, Gregory Possehl, and others have highlighted the region as a significant cultural zone of the Indus Civilization. With the aid of modern archaeology, geoarchaeology, remote sensing, satellite imagery, GIS, and paleoenvironmental studies, it is now clear that the Nara Basin was not merely an ancient river course but a vast **cultural landscape** where human settlement, agriculture, trade, and cultural activities flourished for millennia.

6.2 History of Archaeological Research
Archaeological study of the Nara Basin can be divided into three phases:

(a) Early Discoveries (19th Century) During the British era, geographers, Survey of India officers, and irrigation engineers noted the spread of ancient river courses, mounds, and ruins in eastern Sindh. Although their surveys were not primarily archaeological, they recorded valuable observations. Key sources include:

- Henry Cousens
- E. H. Aitken
- Bombay Presidency Gazetteers
- Survey of India Records

(b) Systematic Archaeological Surveys (1947–1990) After Pakistan's independence, more organized surveys were conducted in the Nara Basin. During this phase:

- Hundreds of archaeological sites were registered.
- Pottery analysis was used to establish chronological frameworks.
- Different cultural phases were identified.
- Settlement distribution was studied. The most prominent figure of this period was Dr. Mohammad Rafique Mughal, whose research on Cholistan, the Hakra Basin, and eastern Sindh provided foundational insights into Indus settlements, ancient river systems, and environmental change.

(c) Modern Interdisciplinary Research (1990 onwards) From the late 20th century into the 21st, archaeological research adopted new scientific methods:

- Remote sensing
- GIS mapping
- Geoarchaeology
- Sediment analysis
- Radiocarbon dating
- Optically Stimulated Luminescence (OSL)
- Archaeobotany

- Zooarchaeology
- Isotope analysis These approaches allow the Nara Basin to be understood not only through artifacts but as part of a broader environmental and human system.

6.3 Archaeological Significance of the Nara Basin
Modern research highlights several reasons for the basin's importance:

1. **High Settlement Density** – Hundreds of small and large sites indicate the area was heavily populated in antiquity.
2. **Cultural Continuity** – Evidence spans multiple phases:
    - Early Harappan
    - Mature Harappan
    - Late Harappan
    - Historical Period
    - Early Islamic Period This continuity is especially significant compared to other regions of Sindh.
3. **Connection with Ancient River Systems** – Many sites are located near old river courses, wetlands, or palaeochannels, showing the close link between water and settlement.
4. **Eastern Frontier of the Indus Civilization** – Scholars consider the Nara Basin part of the eastern cultural zone of the Indus

Civilization, connected with Cholistan, the Hakra, and Kutch.

6.4 Key Research Questions Current studies of the Nara Basin seek to answer:

- On what basis were ancient settlements established?
- How did water availability influence settlement patterns?
- What was the relationship between river evolution and human habitation?
- How did climate change affect ancient societies?
- How was settlement continuity maintained after the decline of the Indus Civilization?
- What were the trade and cultural links between the Nara Basin, Sindh, Cholistan, and Kutch?

6.5 Structure of the Chapter The following sections will explore:

- Major archaeological sites of the Nara Basin.
- Cultural classification of sites.
- Analysis of pottery, tools, and other artifacts.
- Settlement patterns.
- New findings from GIS and remote sensing.

- Geoarchaeological studies.
- Modern scientific dating methods.
- The Nara Basin's place in global archaeology.

6.6 Conclusion of the Section The study of the Nara Basin demonstrates that it was a vital part of the eastern cultural system of the Indus Civilization. Modern interdisciplinary research presents it not merely as an ancient river course but as an **integrated archaeological landscape**, where natural environment, human settlement, agrarian economy, and regional trade were closely interconnected. The upcoming sections of this chapter will provide a detailed review of archaeological evidence that further clarifies the civilizational significance of the Nara Basin.

Chapter Six

Part Two

Major Archaeological Sites of the Nara Basin: Geographic Distribution, Cultural Features, and Archaeological Significance

6.7 Introduction The strongest evidence of the Nara Basin's archaeological importance lies in the hundreds of sites located here. These sites not only represent different cultural phases of the Indus Civilization but also provide key insights into human settlement, water resources, agrarian economy, trade networks, and environmental change. Research by Dr. Mohammad Rafique Mughal, George F. Dales, Jonathan Mark Kenoyer, Gregory L. Possehl, Rita P. Wright, and others

shows that most Nara Basin sites were situated near ancient river courses (palaeochannels), highlighting the close relationship between water and human habitation.

6.8 Geographic Distribution of Sites The archaeological sites of the Nara Basin are not evenly spread; their distribution is linked to ancient river courses, fertile lands, and natural resources. Most sites are located in:

- Eastern Khairpur
- The Nara belt of Sanghar District
- Umerkot and surrounding areas
- Western edge of Tharparkar
- Strips associated with the ancient Hakra–Nara channels GIS and satellite imagery confirm that the majority of sites lie within a few kilometers of ancient watercourses, reflecting deliberate geographic choices.

6.9 Cultural Classification of Sites Based on archaeological evidence, Nara Basin sites can be divided into the following cultural phases:

(a) Early Harappan (c. 3300–2600 BCE)

- Handmade and wheel-thrown pottery
- Agricultural villages
- Initial settlements

- Local pottery styles

(b) Mature Harappan (c. 2600–1900 BCE)

- Standardized red pottery
- Black geometric designs
- Organized settlements
- Standard weights and measures
- Evidence of trade activities

(c) Late Harappan (c. 1900–1300 BCE)

- Smaller settlements
- New local pottery styles
- Shifts in agrarian economy
- Regional cultural variations

(d) Historical and Islamic Periods Several sites remained occupied in later periods, showing continuity of settlement due to water availability.

6.10 Settlement Hierarchy Modern archaeology classifies Nara Basin sites into different levels:

- **Large central sites** – administrative, economic, and trade centers.
- **Medium-sized sites** – hubs of local production, trade, and agricultural management.

- **Small villages** – permanent or semi-permanent farming and pastoral communities.
- **Seasonal sites** – possibly used only during specific times of the year. This hierarchy reflects the organized settlement system of the Indus Civilization.

6.11 Key Archaeological Sites

(a) Lohum Jo Daro One of the most important Harappan sites in the Nara Basin. Pottery, bricks, beads, and other artifacts suggest it was a well-organized settlement during the Mature Harappan phase. The quality of pottery resembles that of major Indus centers, indicating cultural connections.

(b) Ali Murad A significant site in Sindh, showing evidence from both prehistoric and historical periods. It is crucial for understanding the continuity of settlement in eastern Sindh.

(c) Small Harappan Sites in the Nara Belt Surveys by Dr. Rafique Mughal and others identified numerous small sites of varying sizes. Artifacts found include:

- Harappan pottery
- Stone tools

- Brick fragments
- Beads
- Industrial waste These sites show that settlement in the Nara Basin was not limited to a few major centers.

6.12 Pottery Analysis Pottery is the most important marker for identifying Nara Basin sites. Distinctive features include:

- Fine red ware
- Black geometric designs
- Large storage jars
- Bowls, cups, and water vessels
- Standardized containers Pottery studies have been crucial for dating cultural phases.

6.13 Evidence of Craft Activities Artifacts from several sites indicate craft production:

- Carnelian beads
- Agate fragments
- Faience objects
- Copper tools
- Stone implements
- Bone artifacts These findings show that Nara Basin inhabitants engaged in diverse craft industries.

6.14 Modern Scientific Research Recent studies using:

- GIS mapping
- Drone surveys
- Remote sensing
- Sediment analysis
- Geoarchaeology have identified new sites and ancient river courses. These results suggest that many sites remain buried and could be revealed through future excavations.

6.15 Critical Review Archaeological evidence confirms the Nara Basin as an active part of the eastern Indus Civilization system. However, current scholarship has limitations:

- Many sites have only been surveyed, not excavated.
- Radiocarbon and OSL dating are lacking for most sites.
- GIS and geoarchaeological data remain limited.
- Agricultural activity, urban expansion, and natural erosion have damaged several sites. Thus, further interdisciplinary research is urgently needed.

6.16 Conclusion of the Section The archaeological sites of the Nara Basin demonstrate that this region was an integral part of a vast and organized cultural landscape of the Indus Civilization. Geographic distribution, pottery traditions, craft industries, trade connections, and settlement hierarchies all reveal the central role of ancient watercourses in structuring human life. Modern archaeological and geoarchaeological research strengthens the view that the Nara Basin should be seen not merely as a water channel but as an **integrated archaeological landscape**, where natural environment, human activity, and cultural evolution were closely interconnected. These findings lay the foundation for the next section, which will analyze settlement patterns, palaeoenvironment, and human adaptation using modern scientific approaches.

Chapter Six

Part Three

Settlement Patterns, Palaeoenvironment, and Human Adaptation in the Nara Basin

6.17 Introduction Modern archaeology no longer focuses solely on excavating ancient cities or sites; instead, it emphasizes the study of entire settlement landscapes. Research over the past four decades on the Indus Civilization has shown that understanding cultural evolution requires examining settlement patterns, environmental conditions, water resources, agricultural potential, and trade networks together. The Nara Basin is an ideal case study, where ancient river channels, fertile lands, desert margins, and the Indus Valley converged into a unique ecological system.

Settlement and landscape archaeology reveal that human populations here continuously adapted to environmental changes, reshaping their residential and economic patterns across different periods.

6.18 Theoretical Framework of Settlement Studies Several theoretical approaches guide modern archaeological studies of settlement:

- Settlement Archaeology
- Landscape Archaeology
- Human Ecology
- Behavioural Archaeology
- Resilience Theory
- Cultural Ecology

According to these perspectives, human settlement is never the result of a single factor. Instead, it develops under the combined influence of water, land, climate, natural resources, trade, technology, and social organization. The Nara Basin is best understood through such interdisciplinary frameworks.

6.19 Relationship Between Settlement and Water Most archaeological sites in the Nara Basin are located near palaeochannels, seasonal streams, or natural wetlands. This distribution

reflects the dependence of agrarian economies on water. GIS and remote sensing studies show that:

- Large sites were established near relatively permanent watercourses.
- Smaller agricultural villages clustered around distributaries or seasonal streams.
- Some seasonal sites may have been linked to pastoralism or temporary farming. This pattern closely resembles settlement systems in Punjab, Cholistan, and Kutch.

6.20 Size and Function of Settlements Surveys reveal a clear hierarchy among Nara Basin settlements:

(a) Central Settlements

- Large in area, likely administrative, economic, and trade hubs.
- Features: standardized construction, abundant pottery, craft evidence, large storage jars, and signs of regional trade.

(b) Medium-Sized Villages

- Centers for agricultural collection, local industry, and trade.

(c) Small Agricultural Settlements

- Family or community-based villages focused on farming and pastoralism.

(d) Seasonal Habitations

- Possibly used only during specific seasons for grazing or farming.

6.21 Palaeoenvironment Studies of sediments, pollen, plant remains, animal bones, and satellite data reveal:

- Early and middle Holocene climate was relatively moist.
- River flows were more active than today.
- Floods deposited fertile soils, supporting agriculture.
- Later, gradual aridity reduced water availability.

6.22 Human Adaptation Despite climatic and environmental changes, Nara Basin communities adapted in multiple ways:

- Shifting settlement locations.
- Utilizing new water sources.
- Diversifying crops.

- Increasing reliance on pastoralism.
- Expanding trade networks. This shows Indus societies were dynamic and responsive rather than static.

6.23 Environmental Change and Settlement
Earlier theories suggested sudden river desiccation caused abrupt abandonment. Modern research, however, indicates:

- River changes occurred in phases.
- Different areas were affected at different times.
- Some settlements disappeared, while others persisted.
- Populations often relocated to new water sources. This reflects **civilizational transformation** rather than simple collapse.

6.24 GIS and Remote Sensing Findings Satellite imagery and GIS analysis reveal:

- Many ancient river channels remain buried.
- Most archaeological sites are linked to these channels.
- Distances between sites suggest planned settlement distribution.

- Evidence of ancient trade routes has also been identified. These findings are crucial for reconstructing ancient landscapes.

6.25 Critical Review Key insights from settlement studies in the Nara Basin:

1. Water availability was central, but not the sole factor in settlement.
2. Fertility, trade, social organization, resource access, and climate also shaped habitation.
3. Interdisciplinary research shows the Nara Basin was not just a “Hakra river margin” but a complex cultural and ecological system.
4. Future studies using radiocarbon dating, OSL, micromorphology, and archaeobotanical/archaeozoological analysis can refine our understanding of settlement evolution.

6.26 Conclusion of the Section Settlement patterns in the Nara Basin reveal a dynamic cultural landscape shaped by the interplay of natural environment and human agency. Ancient river channels, agricultural resources, trade

networks, and adaptive strategies produced diverse settlement forms that integrated into the wider Indus socio-economic system. Modern landscape archaeology, geoarchaeology, and remote sensing reinforce the view that the Nara Basin should be seen not merely as a cluster of sites but as an **integrated archaeological landscape**, where environment, river systems, and human activity interacted continuously for millennia. This discussion sets the stage for the next section, which will analyze the **material culture** of the Nara Basin—pottery, seals, beads, metal tools, architectural remains, and other artifacts—in detail.

Chapter Seven

Material Culture of the Nara Basin: Analytical Study of Archaeological Evidence

7.1 Introduction Material culture is the cornerstone of archaeological research, since most of our knowledge about ancient societies comes from the objects they created and used in daily life, economic activities, religious rituals, and social interactions. Pottery, seals, beads, metal tools, bricks, bone artifacts, and ornaments are not merely utilitarian items—they are indicators of technology, economic organization, artistic taste, trade relations, and cultural identity. The material culture recovered from the Nara Basin shows strong similarities with other Indus Civilization centers such as Mohenjo-daro, Harappa, Kot Diji, Chanhu-daro, Amri, Lothal, Dholavira, and Ganweriwala, while also displaying

local features that highlight the region's unique cultural trajectory.

7.2 Concept of Material Culture In modern archaeology, material culture refers to all physical remains produced by human activity, including:

- Pottery vessels
- Stone and metal tools
- Seals
- Beads and ornaments
- Architectural remains
- Bone and shell artifacts
- Agricultural implements
- Ritual and religious objects

Contemporary theories such as **Behavioural Archaeology** and **Material Culture Studies** interpret these artifacts not only as functional items but as reflections of human thought, social identity, and cultural practices.

7.3 Pottery *Introduction* Pottery is among the most diagnostic artifacts of the Indus Civilization. In the Nara Basin, pottery provides crucial evidence for identifying cultural phases, establishing chronology, and tracing regional connections.

Technology Studies reveal that:

- The fast potter's wheel was used.
- Selected clays were employed.
- Vessels were fired at high temperatures.
- Standardized production techniques were followed. This reflects the advanced industrial skills of the Indus Civilization.

Types Pottery types found in the Nara Basin include:

- Large storage jars
- Bowls
- Dishes
- Water pots
- Dish-on-stand forms
- Perforated jars
- Small ritual vessels

Decoration Common motifs painted in black include:

- Horizontal and vertical lines
- Triangles
- Circles
- Wave patterns
- Net-like designs
- Stylized plant motifs
- Limited animal symbols These designs align with the artistic traditions of the Indus Civilization.

7.4 Regional Pottery Features Although much of the Nara Basin pottery follows Harappan standards, certain local traits are evident:

- Variations in vessel size
- Distinctive local decorations
- Differences in clay texture
- New styles in the Late Harappan phase These features indicate local production and cultural diversity.

7.5 Significance of Pottery Pottery analysis provides insights into:

- Cultural phases
- Trade connections
- Local industries
- Dietary habits
- Storage practices
- Social organization
- Technological development Thus, pottery is considered the most important diagnostic artifact in archaeological research.

7.6 Seals Seals from the Nara Basin are few but highly significant. Typical Indus seals are:

- Square-shaped
- Made of steatite
- Decorated with animal motifs

- Inscribed with undeciphered Indus script

The presence of seals at a site indicates its administrative, economic, or trade importance.

7.7 Critical Review The material culture of the Nara Basin demonstrates that it was an active part of the broader Indus cultural system. High-quality pottery, standardized technology, and the presence of seals suggest local industry, trade, and social organization. At the same time, regional variations show that the Nara Basin was not merely imitating major centers but developing its own cultural identity shaped by local resources and environment.

7.8 Conclusion of the Section Pottery and seals from the Nara Basin provide vital evidence for understanding the region's civilizational, economic, and artistic development. They show that local communities were integrated into the technological and trade networks of the Indus Civilization while maintaining distinctive traditions. This discussion sets the stage for the next section, which will analyze **beads, ornaments, metallurgy, stone tools, bone and shell industries, and other elements of material culture** in detail.

Chapter Seven

Part Two

Beads, Ornaments, Metallurgy, Lithic Tools, and Other Craft Industries: Archaeological Review

7.9 Introduction Beyond pottery, some of the most significant elements of Indus material culture are beads, ornaments, metallurgy, lithic tools, bone artifacts, and shell industries. These finds not only highlight technological progress but also provide evidence of trade networks, raw material procurement, craft organization, social status, and economic specialization. Discoveries from the Nara Basin confirm that this region was an active participant in the wider industrial and commercial system of the Indus Civilization,

combining local production with imported raw materials and long-distance trade.

7.10 Bead Industry *Overview* Beads represent one of the most refined crafts of the Indus Civilization. Numerous varieties have been recovered from Nara Basin sites, reflecting both technical skill and interregional trade.

Raw Materials

- Carnelian
- Agate
- Chalcedony
- Jasper
- Lapis lazuli (limited)
- Faience
- Terracotta
- Shell

Many of these were non-local, showing long-distance trade connections.

Production Process

- Selection of raw stone
- Cutting and shaping
- Polishing
- Drilling
- Final finishing

Carnelian beads often underwent heat treatment to enhance color—a hallmark of Indus craftsmanship.

Types

- Spherical
- Cylindrical
- Barrel-shaped
- Disc beads
- Seed beads
- Long carnelian beads

Several styles closely resemble finds from Mohenjo-daro, Chanhu-daro, and Lothal.

7.11 Ornaments Jewelry reflects social status, aesthetic taste, and economic conditions. Finds from the Nara Basin include:

- Bangles
- Necklaces
- Pendants
- Earrings
- Rings
- Copper bracelets
- Shell bangles
- Faience ornaments

The diversity of raw materials indicates skilled craftsmanship and cultural sophistication.

7.12 Metallurgy The Indus Civilization flourished during the Chalcolithic–Bronze Age. Nara Basin finds confirm the presence of metallurgy, though on a smaller scale compared to major centers.

Metals Used

- Copper
- Bronze
- Gold (limited)
- Silver (limited)

Artifacts

- Knives
- Needles
- Chisels
- Arrowheads
- Fishhooks
- Small agricultural tools

These items show the integration of metallurgy into daily life, agriculture, and craft production.

7.13 Lithic Industry Despite the rise of metals, stone tools remained widely used. Key finds include:

- Blades
- Scrapers
- Borers
- Knives
- Carving tools

Most were made from chert and other fine stones.

Blade Technology

- Long blades produced with precision
- Standardized dimensions
- Mass production
- Specialized craftsmen involved

7.14 Bone Industry Bone artifacts were an important craft tradition. Finds include:

- Needles
- Pins
- Drilling tools
- Decorative items
- Small implements

These were skillfully crafted from animal bones.

7.15 Shell Industry Shell artifacts are strong evidence of long-distance trade, since the Nara Basin is far from the sea.

Implications

- Raw materials imported from coastal regions
- Organized trade networks
- Local artisans crafted ornaments from shell

Artifacts

- Bangles
- Beads
- Pendants
- Decorative items

7.16 Organization of Craft Industries
Archaeological evidence suggests two levels of production:

- **Household craft production** – everyday items made within homes.
- **Specialized craft production** – high-quality beads, metal objects, and fine ornaments produced by skilled artisans.

This division reflects social organization and economic specialization.

7.17 Interregional Trade Material culture shows trade links with:

- Mohenjo-daro

- Harappa
- Chanhu-daro
- Kot Diji
- Cholistan
- Kutch
- Gujarat
- Makran
- Balochistan

Indirect connections likely extended to Afghanistan, Iran, and coastal regions of the Arabian Sea.

7.18 Critical Review Craft industries in the Nara Basin demonstrate that this region was not merely agricultural but also industrial and commercial. However, several gaps remain:

- Lack of metallurgical analysis of metal artifacts.
- Need for provenance studies of bead raw materials.
- Limited research on bone and plant remains.
- Few excavations of artisan workshops.

Future interdisciplinary studies could provide a clearer picture of the region's economic history.

7.19 Conclusion of the Section Beads, ornaments, metal tools, stone blades, bone and shell artifacts from the Nara Basin confirm its role as an integral part of the Indus Civilization's industrial and trade networks. These finds highlight local craft traditions, regional specialization, long-distance commerce, and advanced technical skills. The evidence shows that the Nara Basin was not simply an agricultural or water-based zone but a **civilizational hub** where industry, trade, craft production, and cultural exchange flourished together. The next section will examine the **trade system, communication routes, economic organization, and interregional connections** of the Indus Civilization in greater detail.

Chapter Seven

Part Three

Trade System, Communication Routes, and Economic Organization of the Nara Basin: Analytical Review of Interregional Connections in the Indus Civilization

7.20 Introduction The Indus Civilization was not only one of the world's earliest urban cultures but also a highly organized economic and trade system. Agriculture, industry, craft production, and commerce were interconnected pillars of its development. The Nara Basin played a crucial role in this system, serving as a geographic corridor linking the Indus Valley with Cholistan, Thar,

Kutch, and Gujarat. Modern archaeology, geoarchaeology, GIS, remote sensing, and material culture studies reveal that the Nara Basin was more than an agricultural zone—it was a hub for raw material exchange, craft distribution, and regional trade.

7.21 Economic System of the Indus Civilization
Core elements of the Indus economy included:

- Agriculture
- Pastoralism
- Craft industries
- Interregional trade
- Riverine and overland transport
- Standardized weights and measures

Artifacts from the Nara Basin confirm its integration into this broader economic framework.

7.22 Geographic Importance of the Nara Basin
The basin functioned as a natural communication corridor, connecting:

- The main Indus Valley
- Cholistan (Hakra Basin)
- Thar Desert
- Rann of Kutch
- Coastal Gujarat

Its location made it an ideal route for caravans and local exchanges.

7.23 Overland Trade Routes Evidence suggests multiple ancient land routes passed through the Nara Basin, used for:

- Transporting raw materials
- Trading agricultural produce
- Distributing craft goods
- Linking settlements

GIS studies show these routes often followed river channels and water sources, ensuring safer travel.

7.24 Riverine Connections Although scholarly debate continues, some researchers argue that when water flow was stronger, local transport by boats or small watercraft was possible. Large-scale river trade remains unproven, but the basin likely combined land and seasonal water routes.

7.25 Trade Commodities Items produced or exchanged in the Nara Basin included:

Agriculture

- Wheat
- Barley
- Oil crops
- Fodder plants

Pastoralism

- Cattle
- Sheep
- Goats
- Camels

Crafts

- Beads
- Pottery
- Stone tools
- Shell ornaments
- Metal implements

Raw Materials

- Carnelian
- Agate
- Chert
- Copper
- Timber

Some were locally produced, others imported.

7.26 Standardized Weights and Measures Like Mohenjo-daro, Harappa, and Lothal, the Nara Basin shows indirect evidence of standardized weights. This indicates:

- Organized trade

- Regulated measurement systems
- Shared economic standards across regions

7.27 Interregional Trade Links Connections extended to:

Sindh – Mohenjo-daro, Chanhu-daro, Kot Diji, Amri *Punjab* – Harappa *Cholistan* – Ganweriwala, Hakra Basin sites *Balochistan* – Nal, later Mehrgarh cultural zones *Gujarat* – Lothal, Dholavira, Rangpur

These ties confirm the Nara Basin's role in the Indus economic network.

7.28 Long-Distance Trade Evidence suggests indirect links beyond South Asia:

- Afghanistan (lapis lazuli)
- Oman (copper)
- Iran
- Mesopotamia

Indus seals found in Mesopotamia highlight the civilization's international trade, in which the Nara Basin likely participated.

7.29 Economic Organization The Nara Basin economy was based on:

- Agriculture

- Pastoralism
- Local crafts
- Regional trade
- Interregional commerce
- Organized resource distribution

This diversified economy shows the basin was not dependent solely on farming.

7.30 Critical Review of Modern Research Recent findings emphasize:

- The Nara Basin was an **economic corridor**, not just a remnant of the Hakra River.
- GIS and remote sensing have been vital in reconstructing trade routes.
- Material culture confirms raw material transfer and regional links.
- However, precise dating and usage of trade routes require further fieldwork.

7.31 Conclusion of the Section The Nara Basin's geography, archaeological evidence, and modern scientific studies demonstrate its role as a vital link in the Indus Civilization's economic and trade system. Through land routes, craft industries, agricultural exchange, and raw material distribution, it connected Sindh, Cholistan, Kutch, Gujarat, and beyond. Thus, the Nara Basin should be understood not merely as an ancient

watercourse or agricultural zone but as an **Economic and Communication Corridor** that contributed significantly to the stability, interregional connections, and cultural evolution of the Indus Civilization. This analysis sets the foundation for the next section, which will explore the **religious, social, and cultural life of the Nara Basin—burial traditions, symbols, and worldview—through archaeological evidence.**

Chapter Seven

Part Four

Social, Religious, and Cultural Life of the Nara Basin: A Critical Study in Light of Archaeological Evidence

7.32 Introduction Studying the social and religious life of the Indus Civilization is one of archaeology's most complex tasks, since the Indus script remains undeciphered. Consequently, scholars rely on material culture, architectural remains, burial practices, figurines, seals, and other artifacts to infer social organization, beliefs, and traditions. Finds from the Nara Basin show that its communities were part of the broader Indus cultural system, while also developing distinctive traits shaped by local environment, economy, and geography. Modern approaches in **Social Archaeology**, **Cognitive Archaeology**, and **Landscape Archaeology** emphasize interpreting Nara's society not as a uniform centralized system

but as a mosaic of local communities and their interactions.

7.33 Social Organization Although direct evidence of social hierarchy is scarce, settlement size, house structures, craft specialization, and industrial distribution provide clues:

- Settlements were organized and planned.
- Division of labor existed in agriculture and crafts.
- Some sites functioned as economic centers.
- Smaller villages were linked to these hubs. This suggests a structured society, though without clear signs of monarchic rule like Egypt or Mesopotamia.

7.34 Family Life Residential architecture indicates multi-room houses with spaces for:

- Living quarters
- Grain storage
- Food preparation
- Craft activities

This points to **extended families** as basic social units, though further excavation is needed for confirmation.

7.35 Religious Beliefs No large temples have been found in the Nara Basin, but material culture provides hints:

- Terracotta human figurines
- Animal motifs on seals
- Symbolic designs
- Ritual vessels
- Fire-related structures (interpretation debated)

These suggest beliefs tied to fertility, nature, animals, and symbolic rituals, though definitive interpretations remain elusive.

7.36 Seals and Symbolic World Indus seals were not only trade tools but also carried symbolic or religious meaning. Nara Basin seals depict:

- Unicorn motif
- Bull
- Elephant
- Goat
- Other animals
- Indus script signs

Their meanings remain undeciphered, so cautious interpretation is essential.

7.37 Burial Practices Evidence of burials in the Nara Basin is limited, as few cemeteries have been excavated. Based on parallels with other Indus sites:

- Simple earth graves
- Specific orientation of bodies
- Accompanying pottery vessels
- Occasional ornaments
- Everyday items placed with the deceased

Future excavations may reveal more about local funerary traditions.

7.38 Art and Aesthetic Sense Artifacts show Nara Basin inhabitants valued aesthetics:

- Painted pottery
- Bead necklaces
- Shell and faience ornaments
- Well-crafted seals
- Finely made tools

Art was not merely decorative but also a medium of social identity and cultural expression.

7.39 Social Differentiation Key questions concern social stratification. Evidence suggests:

- Some houses were larger than others.

- High-quality artifacts concentrated at certain sites.
- Craft specialization was present.

Yet, unlike Egypt or Mesopotamia, there is no evidence of kings, palaces, or monumental tombs. Scholars therefore view the Indus society as relatively egalitarian but professionally specialized.

7.40 Cultural Continuity Archaeological evidence shows:

- Continuous settlement from Early Harappan times.
- Peak development during the Mature Harappan phase.
- Shifts in the Late Harappan period.
- Human habitation persisted into historical times.

This continuity indicates adaptation rather than abrupt collapse.

7.41 Critical Review of Modern Research Recent studies highlight:

- Earlier theories of Nara's social life were based on limited evidence.

- Religious interpretations must remain cautious due to undeciphered script.
- More data is needed from residential structures, DNA, isotopes, and bioarchaeology.
- Interdisciplinary approaches now provide more balanced reconstructions.

7.42 Conclusion of the Section The social, religious, and cultural life of the Nara Basin reveals a community integrated into the Indus Civilization yet shaped by local adaptations. Organized social structures, advanced crafts, symbolic art, and resilient traditions characterized its people. At the same time, current evidence warns against drawing absolute conclusions about political or religious systems. The Nara Basin is best understood as a **dynamic, multi-faceted, and evolving cultural landscape**, where society, belief, and identity were continuously negotiated in response to environment and economy.

This sets the stage for the next section, which will explore **burial traditions, symbolic expressions, and the intellectual world of the Nara Basin** in greater depth.

Chapter Seven

Part Five

Decline of the Nara Basin, Environmental Changes, and the Hakra–Nara Debate: A Critical Review in Light of Modern Scientific Research

7.43 Introduction The decline of the Indus Civilization remains one of the most debated topics in South Asian archaeology. Early scholars in the 19th and early 20th centuries often attributed this decline to single causes such as river desiccation, floods, or invasions. However, over the past three decades, advances in **geoarchaeology, paleoclimatology, remote sensing, OSL dating, radiocarbon analysis, and sedimentology** have revealed a far more complex and nuanced picture. The Nara Basin is central to this debate because of its association with ancient

river systems, the Hakra–Ghaggar network, and the eastern settlements of the Indus Civilization.

7.44 Early Theories of Decline Past explanations included:

- Aryan invasion theory
- Catastrophic floods
- Sudden drying of the Hakra/Saraswati River
- Epidemics
- Economic collapse

Modern scholarship has largely rejected or minimized these single-cause theories. In particular, the Aryan invasion hypothesis is no longer widely accepted due to lack of archaeological evidence.

7.45 Environmental Changes During the mid-to-late Holocene, South Asia experienced gradual climatic shifts:

- Variability in monsoon intensity
- Increased climatic unpredictability
- Expansion of aridity in some regions
- Progressive changes in river flows

These changes affected agriculture, water availability, and settlement sustainability, though impacts varied across regions.

7.46 Shifts in River Systems Geoarchaeological studies show that ancient rivers were dynamic, not static:

- Palaeochannels were active at different times.
- Some flows were seasonal.
- Certain channels were reused in later periods.
- Shifts in the Indus River also influenced the basin.

Thus, linking the Nara corridor to a single ancient river system oversimplifies the evidence.

7.47 The Hakra–Nara Debate Scholarly opinion divides into three major perspectives:

(a) Traditional View

- Ghaggar, Hakra, and Nara were parts of a continuous river system flowing from the Himalayas to Sindh.
- Later course changes led to desiccation. This view was popular among early geographers and archaeologists.

(b) Revisionist View

- Different segments of the Ghaggar–Hakra system had distinct histories.

- Not all channels were active simultaneously.
- Many flows were seasonal.
- Local water systems also existed in the Nara Basin. This interpretation is supported by satellite imagery, sediment studies, OSL dating, and geophysical surveys.

(c) Multi-Channel Model

- Eastern Sindh and Cholistan hosted multiple river courses.
- Their activity shifted over time.
- Human settlements adapted to these changes. This model is currently the most widely accepted among geoarchaeologists.

7.48 Archaeological Evidence from the Nara Basin Findings indicate:

- Many sites were located near water sources.
- Settlements show occupation across different phases.
- Habitation continued into the Late Harappan period.
- Population shifts occurred gradually, not abruptly.

This suggests transformation rather than sudden collapse.

7.49 Modern Scientific Methods Recent studies employ:

- Remote sensing
- GIS mapping
- OSL and radiocarbon dating
- Sedimentology and micromorphology
- Stable isotope analysis
- Archaeobotany and zooarchaeology
- Geomorphological surveys

These methods provide more precise reconstructions of rivers, settlements, and environmental changes.

7.50 Critical Review Key conclusions:

1. The decline of the Indus Civilization cannot be explained by a single cause.
2. Environmental changes were significant but interacted with social, economic, and technological shifts.
3. The Hakra–Nara debate remains unresolved; definitive claims are premature.
4. Interdisciplinary research combining archaeology, geology, hydrology,

climatology, and environmental science offers the most balanced approach.

7.51 Future Research Directions Areas needing further study include:

- Excavation of unexplored sites
- Expanded OSL and radiocarbon dating
- Archaeobotanical and zooarchaeological analysis
- Ancient DNA studies
- High-resolution satellite mapping of palaeochannels
- Collaborative research across Pakistan and India on the Hakra–Ghaggar–Nara system

7.52 Conclusion of the Section Modern research shows that the Nara Basin is vital for understanding the Indus Civilization's history, environmental evolution, and river dynamics. The decline was not the result of a single catastrophe or one river drying up, but a **long-term, multi-causal process** involving climate shifts, river changes, economic adaptations, and social transformations. The most balanced conclusion is that the Nara Basin should not be seen solely as the continuation of the Hakra River or merely as a colonial irrigation product. Instead, it represents a **dynamic cultural and environmental landscape**,

shaped over millennia by the interplay of natural forces and human agency.

This prepares the ground for the next chapter, which will synthesize the **overall historical, geographical, and archaeological significance of the Nara Basin** in the broader context of Sindh's past.

Chapter Eight

Conclusions, Scholarly Analysis, Research Discussion, and Future Directions

8.1 Introduction The Nara Basin holds fundamental importance in the study of Sindh's historical geography, archaeology, geoarchaeology, and environmental history. This research has critically examined the historical, geographical, hydrological, and archaeological significance of the Nara in light of modern scientific studies. It has become clear that describing the Nara solely as a present-day irrigation canal or merely as the ancient bed of the Hakra River does not align with scientific evidence. Rather, the basin represents the **co-evolution of natural and human processes** over thousands of years. Modern archaeology, satellite remote sensing, geophysical surveys, sediment analysis, radiocarbon dating, OSL dating, and GIS

have reshaped earlier conceptions. These studies demonstrate that the Nara Basin is a **dynamic cultural and environmental landscape**, whose history cannot be confined to a single river or era.

8.2 Key Findings

(a) Historical Importance The Nara Basin has been a crucial geographical and cultural zone in Sindh's ancient history, serving as a natural corridor linking the Indus Valley, Hakra Basin, Thar, Kutch, and Gujarat. Archaeological evidence confirms continuous human settlement from the Early Harappan period through historical times.

(b) Ancient River Systems Geoarchaeological research shows that palaeochannels in the Nara Basin were active at different times:

- Ancient water systems changed over time.
- Not all channels flowed simultaneously.
- Climatic and tectonic changes altered river courses.

(c) Connection with the Indus Civilization Finds of pottery, seals, beads, metal tools, residential structures, and agricultural evidence confirm that the Nara Basin was an active part of the Indus Civilization's urban, economic, and cultural system.

8.3 Critical Review of the Hakra–Nara Debate

- Multiple ancient river courses existed in the Nara Basin.
- Some may have been linked to the Hakra–Ghaggar system.
- Current evidence does not prove that the modern Nara is a direct continuation of a single Himalayan river.
- Local streams, old Indus courses, and seasonal flows also played roles. Thus, modern scholarship favors a cautious, multi-causal interpretation.

8.4 Environmental Changes and Human Adaptation

- Gradual aridity and shifts in monsoon patterns affected agriculture.
- River courses changed, altering water availability.
- Communities adapted through migration, crop diversification, increased pastoralism, expanded trade, and use of new water sources. This reflects the **resilience** of Indus social systems.

8.5 Archaeological Significance Finds show the Nara Basin was not merely agricultural:

- Craft industries flourished.
- Organized trade existed.
- Skilled artisans produced advanced goods.
- Strong regional and interregional connections were maintained. Thus, it should not be considered a marginal zone of the Indus Civilization.

8.6 New Research Trends

- **Geoarchaeology:** Studying sediments and landforms to reconstruct river histories.
- **Remote Sensing:** Identifying buried palaeochannels via satellite imagery.
- **GIS:** Integrating settlement, trade routes, and water systems.
- **Archaeobotany:** Revealing ancient crops and agricultural practices.
- **Bioarchaeology:** Providing insights into diet, health, and migration.

8.7 Research Limitations

- Many sites remain unexcavated.
- Some areas have been damaged by modern agriculture.
- Political boundaries limit integrated study of the entire basin.
- Chronologies of several sites remain uncertain.

8.8 Recommendations for Future Research

1. Comprehensive archaeological survey with GIS mapping.
2. Scientific excavations at unexplored sites.
3. Improved chronology through radiocarbon and OSL dating.
4. Detailed geoarchaeological sediment studies.
5. Expanded archaeobotanical research.
6. Zooarchaeological analysis of animal remains.
7. Ancient DNA studies where possible.
8. International collaboration between Pakistan, India, and global institutions.

8.9 Conclusion The Nara Basin is a key region for understanding Sindh's ancient history, the Indus Civilization, the Hakra–Ghaggar system, ancient environments, and human adaptation. Modern science confirms that its history is **multidisciplinary**, requiring perspectives from archaeology, geography, hydrology, climatology, and environmental studies. Its civilizational importance lies in being a center of human settlement, agriculture, trade networks, and environmental change for millennia. The archaeological record not only enriches our understanding of the Indus Civilization but also contributes to global debates on ancient river

systems, urban societies, and human resilience. The most balanced conclusion is to view the Nara Basin as a **dynamic archaeological, hydrological, and cultural landscape**, where natural environment, river systems, human settlement, economic activity, and cultural evolution remained interconnected for thousands of years. Future interdisciplinary research will illuminate many unknown aspects, strengthening our knowledge of Sindh's history and the broader Indus Valley Civilization.

Comprehensive Conclusion

Nara Basin: A Holistic Review of History, Geography, Archaeology, and Modern Scientific Research

This study represents a comprehensive attempt to understand the historical, geographical, hydrological, archaeological, environmental, and civilizational significance of the Nara Basin through modern **interdisciplinary research**. The findings make it clear that describing the Nara merely as the present-day irrigation canal or as the remnant of the ancient Hakra River is scientifically insufficient. Instead, the basin has been shaped over thousands of years by the combined processes of natural environment, river systems, human settlement, agricultural development, trade networks, and cultural evolution.

The research integrated results from **archaeology, satellite remote sensing, GIS, geoarchaeology, sedimentology, radiocarbon dating, OSL dating, archaeobotany, and environmental sciences**, producing a more balanced and scientific picture of the Nara Basin.

Evidence confirms that the Nara Basin was one of the important cultural zones of the Indus Civilization, with continuous settlement from the Early Harappan through the Mature and Late Harappan phases into historical periods. Pottery, seals, beads, metal tools, architectural remains, and agricultural traces demonstrate that the basin was an active part of the Indus trade, agricultural, and industrial networks.

A key conclusion is that the **Hakra–Nara debate** cannot be explained by a single theory. Modern geoarchaeological and hydrological studies show that multiple palaeochannels were active at different times. Some may have been linked to the Hakra–Ghaggar system, while others were associated with ancient Indus distributaries or local seasonal streams. Thus, the Nara Basin is best understood as an **evolving fluvial landscape**.

The decline of the Indus Civilization was not the result of one sudden event. Scientific evidence points to a **long-term, multi-causal process**

involving gradual climatic changes, shifts in river courses, agricultural adjustments, economic adaptations, and phased population movements. Therefore, the concept of “civilizational transformation” is more accurate than “collapse.”

Material culture from the Nara Basin reveals advanced craftsmanship: fine pottery, metallurgy, bead-making, and interregional trade. The use of carnelian, agate, faience, shell, and other raw materials indicates connections with Sindh, Punjab, Balochistan, Cholistan, Kutch, Gujarat, and possibly Afghanistan, Iran, and Mesopotamia.

Geographically, the Nara Basin functioned as a **natural communication corridor**, linking the Indus Valley with Thar, Cholistan, and Kutch, thereby enhancing its economic and civilizational importance.

At the same time, many fundamental questions remain unanswered. Numerous archaeological sites await excavation; the chronology of several palaeochannels is still uncertain; and there is a pressing need for botanical, zoological, genetic, and geochemical studies. Future research using **high-resolution remote sensing, LiDAR, drone surveys, OSL dating, ancient DNA, stable isotope analysis, and geoarchaeology** can provide clearer insights.

In conclusion, the Nara Basin is a region of **international scholarly importance** for studying Sindh's ancient history, the Indus Civilization, river systems, environmental change, and human adaptation. It should be understood not as a single ancient riverbed or a modern irrigation canal, but as an **integrated archaeological, hydrological, environmental, and cultural landscape**, where natural and human factors interacted for millennia to create a unique civilizational setting.

This research contributes not only to Sindh's history and archaeology but also to global debates on ancient environments and civilizations. With future interdisciplinary studies, advanced scientific technologies, and growing interest in heritage preservation, the hidden history and archaeological wealth of the Nara Basin will be illuminated further, enriching our understanding of the Indus Valley Civilization and South Asia's ancient past.

Chapter Nine

Recommendations

9.1 Introduction Based on the findings of this research, the following recommendations are presented to strengthen future studies of the Nara Basin's archaeology, history, palaeoenvironment, hydrological systems, and cultural heritage. These recommendations cover academic, research, institutional, technical, and heritage preservation aspects.

9.2 Archaeological Research Recommendations
9.2.1 Comprehensive Archaeological Survey Re-survey all ancient sites of the Nara Basin using modern tools such as GIS, Differential GPS, drone surveys, and remote sensing to create a complete record of each site's location, extent, preservation status, and historical significance.

9.2.2 Scientific Excavation of Unexplored Sites Hundreds of sites remain unexcavated. Stratigraphic excavations should be conducted

according to international standards to obtain reliable information on settlement, cultural phases, and human activities.

9.2.3 Modern Chronology Apply advanced dating techniques such as:

- Radiocarbon dating
- Optically Stimulated Luminescence (OSL)
- Thermoluminescence (TL) to establish a more precise chronological framework for cultural phases in the Nara Basin.

9.3 Geoarchaeological and Environmental Research 9.3.1 Study of Ancient River Courses Conduct detailed geomorphological, sedimentological, and fluvial geological studies of Nara, Hakra, Puran, and other ancient channels.

9.3.2 Paleoclimatology Encourage research on monsoon variability, floods, and droughts using paleoclimatology and stable isotope analysis.

9.3.3 Ancient Botanical and Biological Studies Use archaeobotany, zooarchaeology, and ancient DNA analysis to reconstruct ancient diets, agriculture, pastoralism, and human migration.

9.4 Recommendations for Hakra–Nara Research 9.4.1 Interdisciplinary Research Combine multiple

fields—archaeology, geology, hydrology, geomorphology, remote sensing, GIS, paleoclimatology, and environmental science—for a holistic study of the Hakra–Nara system.

9.4.2 Pakistan–India Joint Research Since the Hakra–Ghaggar–Nara Basin spans both sides of the international border, collaborative projects between Pakistani and Indian institutions should be encouraged.

9.5 Cultural Heritage Preservation Recommendations 9.5.1 Legal Protection Designate all major archaeological sites of the Nara Basin as protected heritage sites under national law.

9.5.2 Prevention of Illegal Excavation Strengthen monitoring, employ modern technology, and enhance local administrative capacity to prevent illegal digging, smuggling, and destruction of antiquities.

9.5.3 Digital Documentation Create permanent digital records of important sites using:

- 3D scanning
- Photogrammetry
- LiDAR documentation
- Digital mapping

9.6 Academic and Educational Recommendations
9.6.1 University Research Centers Establish specialized centers such as a “Nara Basin Research Centre” or “Hakra–Nara Archaeological Research Unit” in Sindh universities.

9.6.2 International Collaboration Promote joint research, student exchanges, collaborative excavations, and projects with international institutions and universities.

9.6.3 Scholarly Publication Encourage publication of new research on the Nara Basin in peer-reviewed international journals to highlight Sindh’s archaeology in global academic debates.

9.7 Role of Local Communities Local populations must be involved in heritage preservation:

- Launch awareness campaigns.
- Introduce heritage education in schools and colleges.
- Train locals as heritage guides.
- Promote responsible cultural tourism.

9.8 Future Research Priorities Key areas for future study include:

- Preparation of a complete **Archaeological Atlas** of the Nara Basin.

- GIS-based settlement pattern analysis.
- Reconstruction of ancient trade routes.
- Hydrological modeling of Indus Civilization's water systems.
- Full palaeoenvironmental reconstruction of the Nara Basin.
- Ancient DNA and stable isotope studies.
- Botanical, zoological, and geochemical analyses.
- Use of artificial intelligence to identify new sites from satellite imagery.

9.9 Final Recommendation The Nara Basin is not merely an ancient water corridor of Sindh but a **globally significant cultural landscape** for studying South Asia's civilizational history, the evolution of the Indus Civilization, ancient river systems, and human adaptation. Future research must be interdisciplinary, scientific, and internationally collaborative. At the same time, Pakistan's national heritage policy should prioritize the Nara Basin as a key research and cultural zone, ensuring its archaeological sites, historical remains, and natural landscapes are preserved for future generations and presented effectively to the global scholarly community.

Appendices

Introduction This appendix contains supplementary scholarly material, maps, tables, lists, and supporting information used in the research. It clarifies the main text, ensures transparency, and provides future researchers with reference resources. The purpose of these appendices is to show the geographical, archaeological, historical, and scientific evidence upon which the study's conclusions are based.

Appendix A – Geographical Boundaries of the Nara Basin

- **East:** Thar Desert, areas near the Indian border
- **West:** Indus River plains
- **North:** Khairpur, Sukkur, Ghotki
- **South:** Umerkot, Badin, routes toward the Rann of Kutch *Significance:* A natural corridor linking the Indus Valley, Hakra Basin, Thar, and Kutch since antiquity.

Appendix B – Major Archaeological Sites of the Nara Basin

Site	District	Cultural Phase
Kot Diji	Khairpur	Early Harappan, Mature Harappan
Amri	Jamshoro	Early Harappan, Mature Harappan
Mohenjo-daro	Larkana	Mature Harappan
Chanhu-daro	Shaheed Benazirabad	Mature Harappan
Lohum Jo Daro	Sanghar	Harappan
Small sites in Thar & Nara Basin	Sanghar, Umerkot	Various phases

Appendix C – Chronological Table of the Indus Civilization

- Early Agricultural Phase: ~7000–5500 BCE
- Early Harappan: ~5500–3300 BCE
- Early Harappan (Urban beginnings): ~3300–2600 BCE
- Mature Harappan: ~2600–1900 BCE

- Late Harappan: ~1900–1300 BCE *Note: Dates vary slightly among scholars.*

Appendix D – Modern Research Methods Applied to the Nara Basin

Method	Purpose
Remote Sensing	Identification of ancient river courses
GIS	Geographical analysis
OSL Dating	Dating sediments
Radiocarbon Dating	Dating organic material
Geoarchaeology	Combined study of environment & archaeology
Sedimentology	Analysis of river deposits
Archaeobotany	Study of ancient plants
Zooarchaeology	Study of animal remains
Stable Isotope Analysis	Diet and environmental conditions

Appendix E – Ancient River Systems Related to the Nara Basin

- Indus River
- Hakra
- Ghaggar
- Puran

- Eastern Nara
- Western Nara
- Ancient channels toward the Rann of Kutch

Appendix F – Key Archaeologists Referenced

- Sir Aurel Stein
- Rafique Mughal
- Jonathan Mark Kenoyer
- Gregory L. Possehl
- Rita P. Wright
- Jane McIntosh
- Bridget Allchin
- Raymond Allchin
- Hugh Trevor Lambrick
- M. H. Panhwar
- Louis Flam
- Michel Danino
- Vasant Shinde
- Liviu Giosan
- Dorian Q. Fuller

Appendix G – Institutions Involved in Nara Basin Research

- Department of Archaeology and Museums, Government of Pakistan
- Sindh Culture, Tourism, Antiquities and Archives Department
- Sindh Archives

- Sindhi Adabi Board
- Geological Survey of Pakistan
- Pakistan Museum of Natural History
- Archaeological Survey of India
- UNESCO
- British Museum
- Harvard University
- University of Wisconsin–Madison
- Deccan College Post-Graduate and Research Institute

Appendix H – Proposed Future Research Projects

1. Complete Archaeological Atlas of the Nara Basin
2. GIS-based digital database of sites
3. 3D documentation of all sites
4. Drone and LiDAR landscape mapping
5. Ancient DNA research
6. Paleoenvironmental reconstruction
7. Computer modeling of ancient trade routes
8. Joint Pakistan–India research projects
9. Scientific documentation for potential World Heritage nomination

Appendix I – Brief Historical Timeline

- ~7000 BCE: Early agricultural settlements in South Asia
- ~3300 BCE: Early Harappan culture begins

- ~2600 BCE: Peak of Mature Indus Civilization
- ~1900 BCE: Transformation into Late Harappan phase
- Historical periods: Settlements linked to Nara and Puran
- 1843 CE: British conquest of Sindh
- 1855–1869 CE: Reorganization of Eastern Nara for irrigation
- 1932 CE: Construction of Sukkur Barrage and modern Nara Canal system

Appendix J – Abbreviations Used in Research

Abbreviation	Full Form
GIS	Geographic Information System
GPS	Global Positioning System
OSL	Optically Stimulated Luminescence
TL	Thermoluminescence
AMS	Accelerator Mass Spectrometry
DNA	Deoxyribonucleic Acid
LiDAR	Light Detection and Ranging
DEM	Digital Elevation Model
RS	Remote Sensing
UNESCO	United Nations Educational, Scientific and Cultural Organization

End of Appendices The tables, lists, and supporting materials included here strengthen the scholarly foundation of this research and provide future researchers with a structured reference and documentation resource.

Glossary of Terms

Introduction This glossary includes the key technical, archaeological, geographical, hydrological, and environmental terms frequently used in this research. Each term is explained briefly and clearly, based on modern scholarly literature.

A

- **Settlement:** A place where humans live permanently or temporarily, such as villages, towns, or seasonal camps.
- **Archaeology :** The scientific study of human past through material remains like buildings, tools, pottery, seals, graves, and other artifacts.

- **Archaeobotany:** Study of ancient plants, seeds, wood, pollen, and other botanical remains to understand agriculture, diet, and environment.
- **Ancient DNA:** Genetic material extracted from ancient human, plant, or animal remains, used to study ancestry, migration, and biological evolution.

B

- **Bioarchaeology:** Study of human bones and biological remains to investigate health, diet, age, and social conditions of past populations.

C

- **Chronology :** Organizing events or cultural phases in their correct time sequence.
- **Cultural Landscape:** A region shaped by the combined influence of natural environment and human activities.

D

- **Digital Elevation Model (DEM):** A computer-generated three-dimensional model of land elevations and depressions.

- **Drone Survey:** Use of drones to capture aerial images for surveying archaeological sites, ancient rivers, and landforms.

F

- **Fluvial Geomorphology:** Scientific study of river flows, sediments, and landform evolution.

G

- **Geoarchaeology:** Combined study of geology and archaeology to understand the relationship between ancient environments, rivers, sediments, and human settlement.
- **Geographic Information System (GIS):** Computer system for collecting, storing, analyzing, and mapping geographical data.
- **Geomorphology:** Study of natural landforms, their evolution, and changes.

H

- **Hydrology :** Science of water flow, storage, distribution, and natural systems.
- **Holocene:** The current geological epoch, beginning about 11,700 years ago.

I

- **Indus Civilization:** Ancient South Asian urban civilization, existing from ~3300–1300 BCE, with its peak between 2600–1900 BCE.
- **Interdisciplinary Research:** Research involving multiple academic fields working together on a single problem.

L

- **LiDAR (Light Detection and Ranging):** Technology using laser beams to survey landforms and elevations with high accuracy.

M

- **Material Culture:** All physical objects created or used by humans, such as tools, pottery, ornaments, seals, and buildings.
- **Micromorphology:** Microscopic study of soil and sediment structures.

O

- **Optically Stimulated Luminescence (OSL):** Dating technique to determine when sediments or sand last came into contact with sunlight.

P

- **Paleochannel:** Ancient river course now inactive but preserved in landforms.
- **Paleoclimatology:** Scientific study of ancient climate and weather history.
- **Photogrammetry:** Technology for creating 3D models and accurate measurements from photographs.

R

- **Radiocarbon Dating (ریڈیوکاربن تاریخنگ):** Scientific method using carbon-14 to determine the age of organic materials.
- **Remote Sensing:** Gathering information about Earth's surface using satellites, aircraft, or drones.

S

- **Sedimentology:** Study of sediments—their composition, origin, arrangement, and evolution.
- **Settlement Pattern:** Analysis of the distribution, size, and relationships of human settlements in a region.
- **Stable Isotope Analysis:** Study of stable isotopes in human, animal, or plant remains to reconstruct diet, water sources, and environment.

- **Stratigraphy:** Study of layers (strata) in soil or archaeological sites and their chronological relationships.

T

- **Tectonic Activity:** Movement of Earth's plates causing earthquakes, land elevation, or changes in river courses.
- **Thermoluminescence (TL):** Dating technique for fired objects like pottery, measuring the time since they were last heated.

Z

- **Zooarchaeology:** Study of ancient animal bones and remains to understand diet, pastoralism, hunting, and environment.

End of Glossary This glossary helps readers, students, and researchers understand the technical terms used in this study with accurate scholarly meaning. It strengthens the academic value of the research, especially in archaeology, geoarchaeology, hydrology, and environmental history.

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